CQ

W2FX

MARCH, 1946

The Radio Amateurs' Journal

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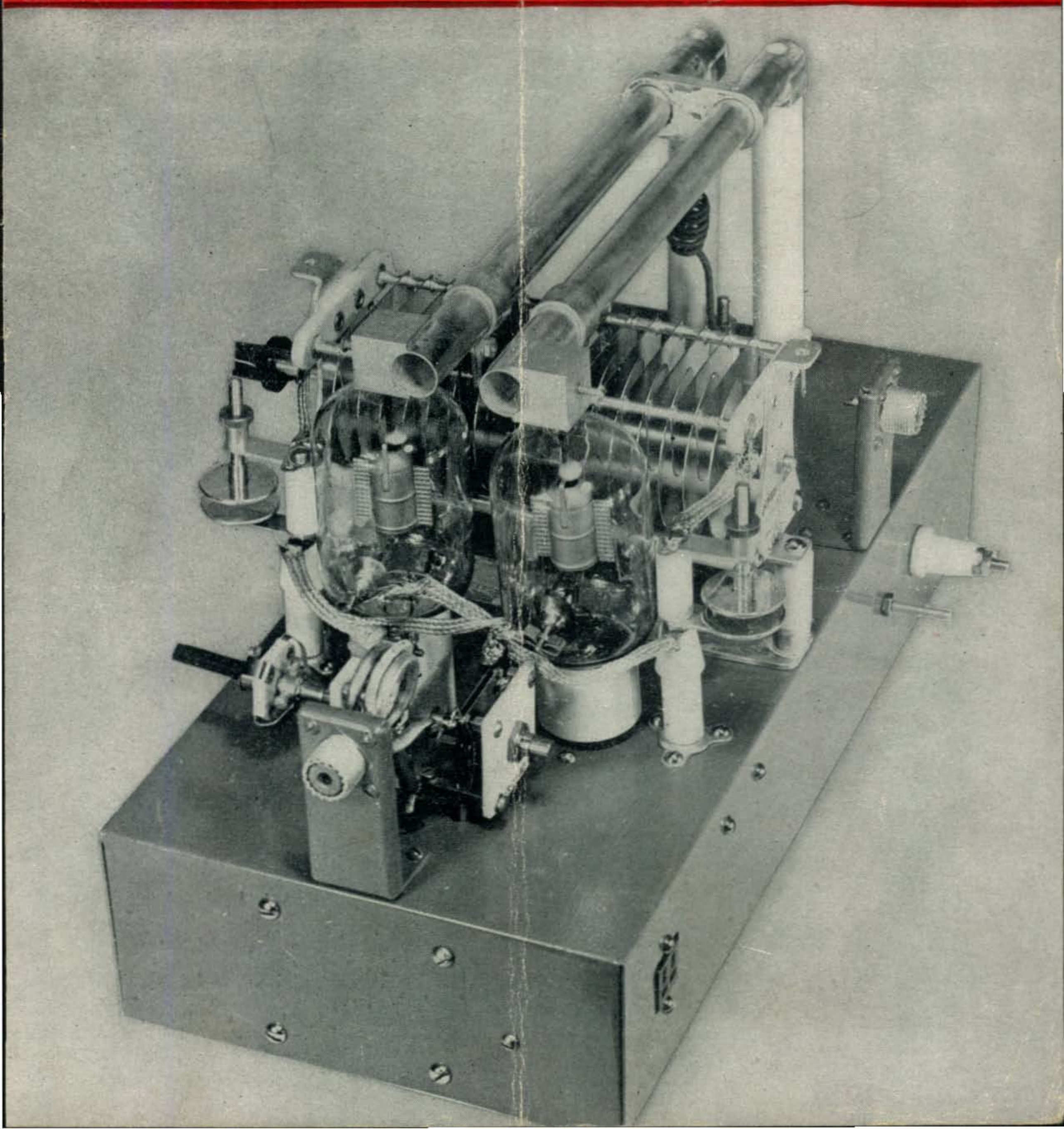


RME GETS *WAC**

So many letters telling us how well RME receivers are performing were received the other morning, we thought we'd see if we had heard from each continent. We had—and quickly made a new kind of WAC without even turning on the transmitter.

Excerpts from these letters tell the story of peak performance the world over—the kind of performance the new 45 is rendering.

EUROPE (From England)
. . . "possessed models of your manufacture and they were the height of engineering as applied to short wave receiver design. The keynote was reliability and the amazing sensitivity." . . .

AFRICA (From Union of South Africa)
. . . "My wartime position of Communications Officer has brought me in touch with your products, and so it has become my ambition to own a really fine communications receiver of your type." . . .

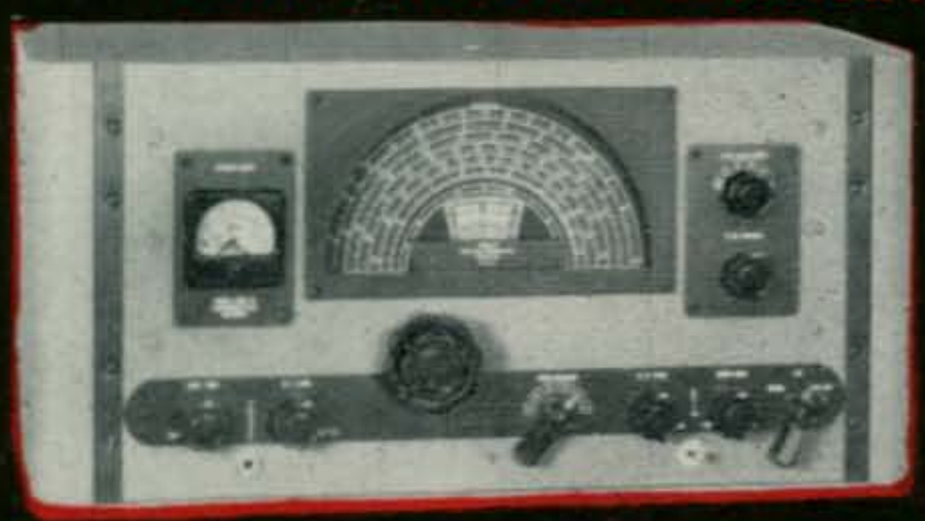
OCEANIA (From Australia a VK3)
. . . "Back in 1935 I was fortunate enough to be able to acquire an RME. This set has performed marvelously." . . .

ASIA (From Ceylon)
. . . "and the technical world outside of Ham-Dom should be told about your receivers." . . .

SOUTH AMERICA (From Brazil a PY7)
. . . "I have an RME 69 that I consider the best receiver I have seen any time." . . .

NORTH AMERICA (From the Aleutians)
. . . "I have one of your 43 receivers here and the reception on it is excellent. I am 3000 miles from Seattle and" . . .

THE NEW RME 45—
ALWAYS A BETTER RECEIVER!



*Worked All Continents

TIME WILL TELL

RME

FINE COMMUNICATIONS EQUIPMENT

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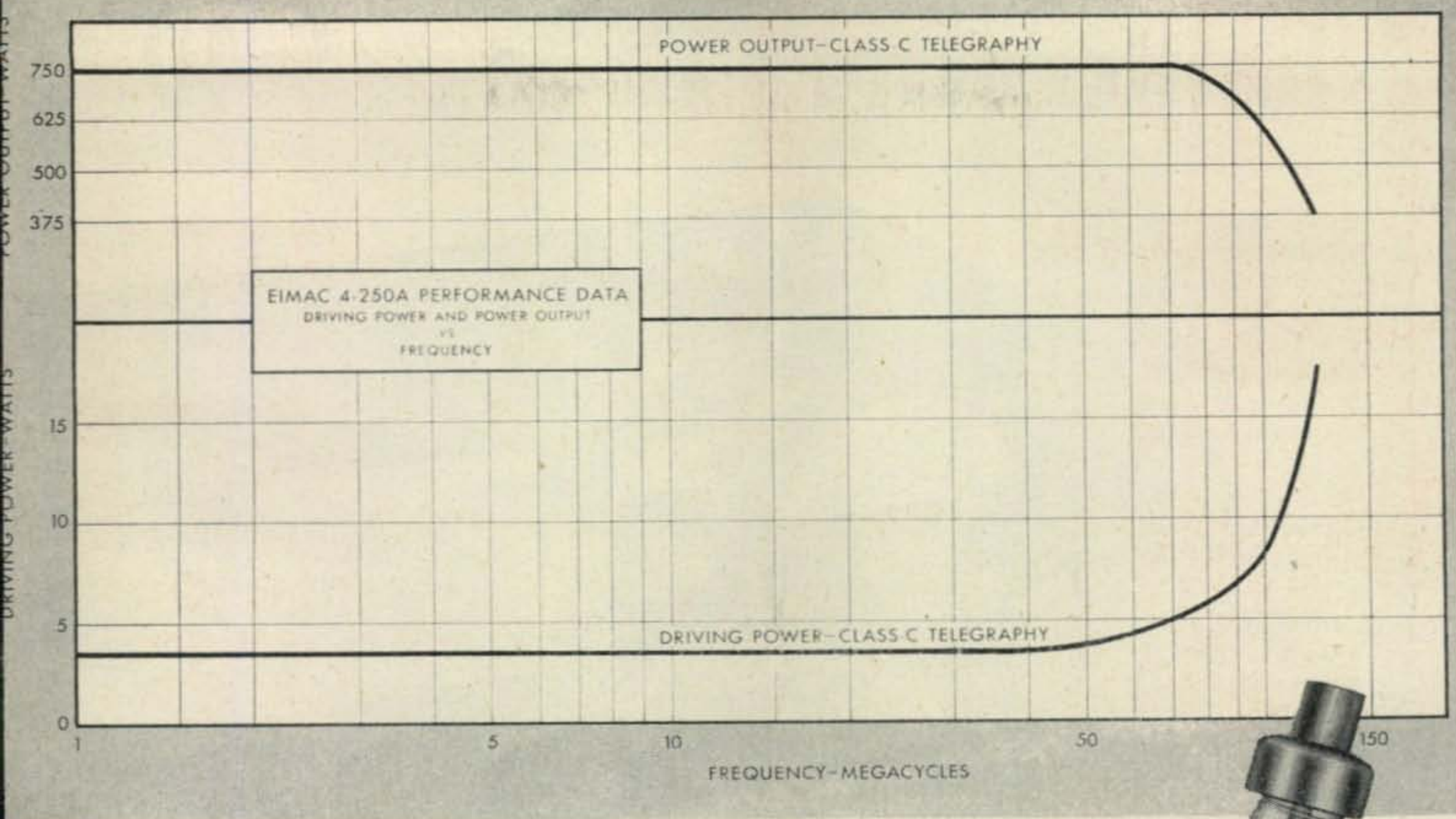
Eimac TUBES

THE COUNTERSIGN OF DEPENDABILITY IN ANY ELECTRONIC EQUIPMENT



NEW EIMAC 4-250A TETRODE

Heading a parade of sensational new tubes now in production, the Eimac 4-250A Tetrode—introduced several months ago—is already in great demand. It may pay to check these performance characteristics against your own requirements.

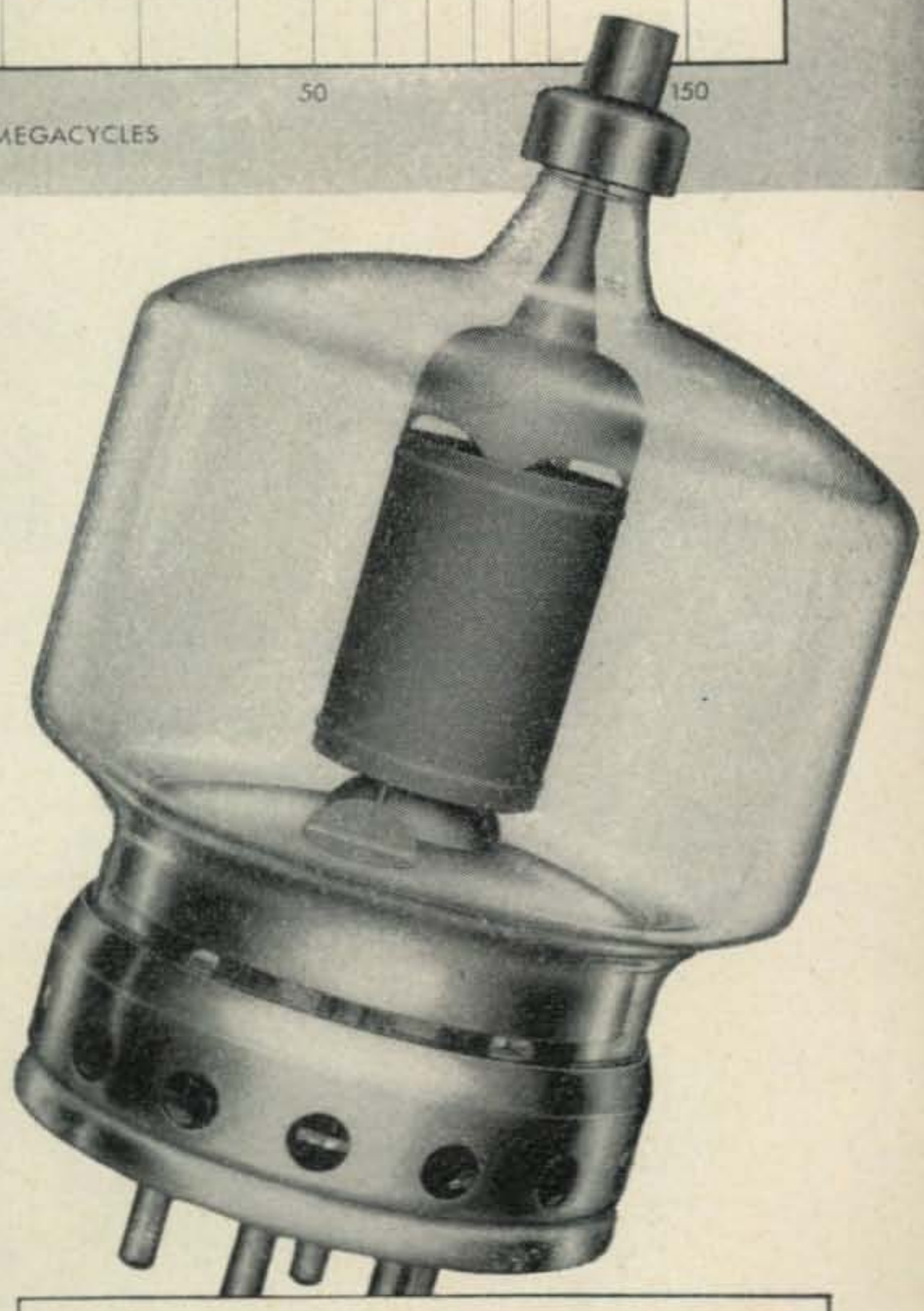
As can be seen by the chart above, the new Eimac 4-250A Tetrode will deliver 750 watts output at frequencies up to 70 Mc. with a driving power of only 5 watts. At frequencies up to 40 Mc. an output of 750 watts may be obtained with a driving power of 3.5 watts.

The grid-plate capacitance of 0.12 *uu*fd. is extremely low, allowing operation at high frequencies without neutralization. Use of Eimac "X" process control grid reduces both primary and secondary emission which provides utmost stability.

You are invited to supplement the information given here with a technical bulletin on Eimac 4-250A Power Tetrode. It contains an elaboration of the tube's characteristics and constant current curves. Send your name and address and a copy will go to you by return mail.

The Lid's Coming Off...
Watch your favorite trade journals for announcements of other new Eimac tubes to be released this year.

CAUTION! Check serial numbers on Eimac tubes before you buy. Be sure you're getting newest types. Look for latest serial numbers.



TYPE 4-250A—POWER TETRODE
ELECTRICAL CHARACTERISTICS

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Plate Dissipation (Maximum)	250 watts
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.12 *uu*fd.
Input	12.7 *uu*fd.
Output	4.5 *uu*fd.
Transconductance (i_B = 80 ma., E_B = 3000 v., E_{C2} = 500 v.)	4000 *u*mhos

FOLLOW THE LEADERS TO

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1086

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New beauty and perfect ventilation in the perforated steel top

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All controls logically grouped for easiest operation. Normal position for broadcast reception marked in red, making possible general use by whole family.

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3-position tone control

Standby receive switch

Phone jack

(APPROXIMATELY)

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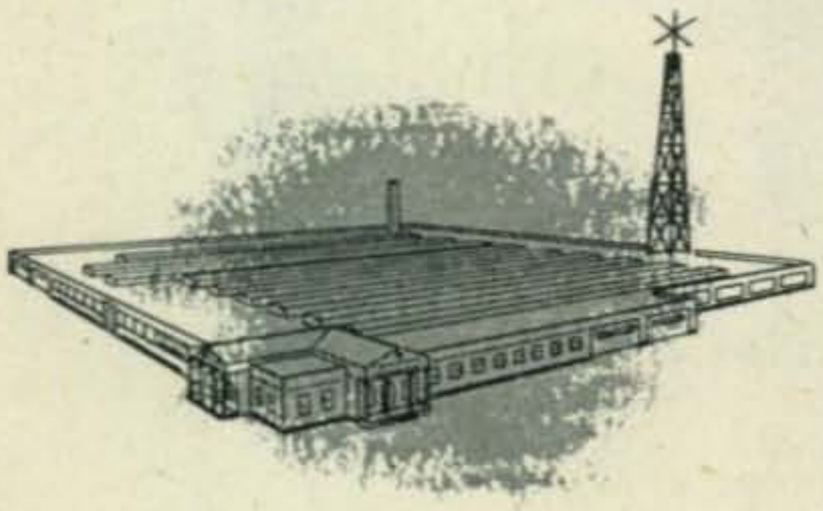
INSIDE STUFF: Beneath the sleek exterior of the S-40 is a beautifully engineered chassis. One stage of tuned radio frequency amplification, the S-40 uses a type 6SA7 tube as converter mixer for best signal to noise ratio. RF coils are of the permeability adjusted "micro-set" type identical with those used in the most expensive Hallicrafters receivers. The high frequency oscillator is temperature compensated for maximum stability.

From every angle the S-40 is an ideal receiver for all high frequency applications.



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CQ The Radio Amateurs' Journal

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VOL. 2, No. 3 MARCH, 1946

COVER

A pair of HK54's in a neutralized lines amplifier. This PA delivers 400 watts output on 144 mc. A complete description of the transmitter will appear in April CQ (Photo by W2TC)

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Here it is!

• Photographic view of the **CALIFORNIA KILOWATT** in open position and ready to transmit or receive.

The **KLUGE** *"California Kilowatt"*

Myron E. Kluge, President of Kluge Electronics, Inc., proudly presents to the radio amateurs of the world a new sensation in radio history, The CALIFORNIA KILOWATT—a "one package" 1000 watt amateur radio station designed and engineered to bring amateur radio out of the attic and the shack and into the living room.

About the size of an ordinary desk, the CALIFORNIA KILOWATT is simply and beautifully designed to fit into your den or living room as neatly and harmoniously as an additional piece of furniture with no clutter or mess. It is completely self-contained with nothing to be added.

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1. A California Kilowatt transmitter with an amazing new tube development—5 band operation with variable frequency control in each band—phone or CW at the throw of a switch—110 or 220 volt operation;

2. Provisions for your choice make of receiver;

3. Built-in speaker — (high fidelity remote speaker also available);

4. Built-in frequency monitor—all band crystal controlled;

5. Built-in world time clock;

6. Illuminated world map with cork backing;

7. Price—the complete CALIFORNIA KILOWATT Station costs far less than you would expect to pay for a transmitter alone.

The CALIFORNIA KILOWATT in closed position

Premiere showings of the Kluge CALIFORNIA KILOWATT will be held in key cities soon throughout the nation by America's leading wholesale distributors. For additional information about the CALIFORNIA KILOWATT write to Kluge Electronics, Inc., Dept. G1, 1031 N. Alvarado Street, Los Angeles 26, Calif.

KLUGE ELECTRONICS INC.

A few territories are still available to qualified distributors. Write or wire Kluge Electronics, Inc.

. . . Zero Bias . . .

At a War Department Conference between ARRL officers and representatives of all United States Military Services held February 21st with FCC representatives also present, it was agreed that Military Services will release frequencies 3700 to 4000 kc on or about March 31st in the continental United States only and subject to continued military use of a few frequencies for a short while on a non-exclusive basis and secondary low-power military use throughout the bands on a non-interfering basis. It is hoped to extend this agreement to territories and possessions soon. While FCC has not yet officially indicated attitude, it is expected it will gladly open these frequencies April 1st including Class A phone 3900 to 4000 kc and plans may be made accordingly. Rest of the band will return later this year. Regarding 7 to 14 mc bands, military hope to accomplish a complete clearance toward the latter part of this year with prospects good for return of substantial portion of each band by midsummer. Military show good feelings and cooperation and are doing everything possible to expedite.

A FEW MONTHS AGO an advertisement appeared in a New York City newspaper featuring war surplus material. What particularly caught our eye was a pair of bolt cutters made for the Signal Corps, selling at a very reasonable price for a heavy-duty, double-action cutter. We had often felt the need for one of these gadgets in routine shop work, and lost no time in filling out a check for $2.50, covering the purchase which was received after some delay.

The "bolt cutter" was not exactly as represented—except for "insulated handles" which were merely tape-wrapped and shellacked. Actually it was a heavy-duty wire cutter with two guides that facilitated entry of the wire into the cutting jaws. The guides had to be hack-sawed off before the tool could be used on light bolts in average locations. The cutter, however, was correctly described as a war surplus item. The casting was plainly labeled, "U. S. SIGNAL CORPS—*1918*."

The moral—if you want to call it that—is fairly obvious, and applies to radio test and operating equipment. Modification may be necessary to render it suitable for amateur or radio service applications, and you may not be able to obtain what you want for a quarter century! Surplus should be bought from legitimate dealers only—those whose advertising appears in recognized radio journals that are anxious to protect the ham, or through personal inspection.

CQ has published several articles on the subject of war surplus radio material, and while many constructive considerations have been evoked and demonstrated, the picture, as a whole, does not justify too much enthusiasm. Though more and more war surplus equipment is trickling into the market, the vast bulk of transmitters, receivers and elaborate test apparatus is being with-held from eager would-be purchasers. Just what is wrong is a matter of conjecture, rumor plus a bit of factual fire to make the smoke. That some usable equipment is deliberately being "cannibalized"—rendered unfit for service and junked—seems to be lamentably true. And this does not apply only to the USA. In Cheadle, Cheshire, England, hundreds of radio sets were recently dumped from trucks into a 150-foot deep mine shaft and adequately interred with a ton or two of earth. These were transmitters and receivers built for the RAF planes, and, according to the Ministry of Aircraft Production, in London, were "surplus unserviceable stock . . . . in need of repairs and of no use to civilians." Regardless of inoperability, the writer is inclined to believe that at least 90% of this buried treasure would have been salvaged by any amateur or radio serviceman.

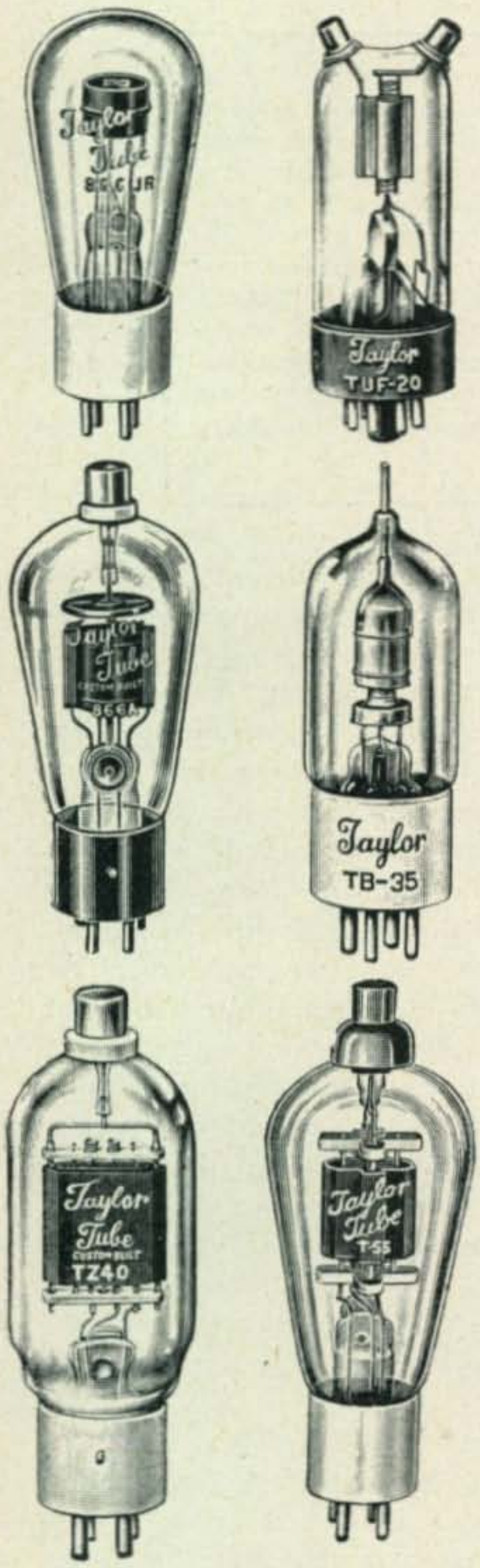
The manufacturer has already made a reasonable profit on the product which he sold to Uncle Sam. Also, such war surplus material as has appeared on the market seems to have been siphoned into the usual trade channels with no one (other than the government) losing money on the transaction. Another consideration is the probability that the vastly increased number of amateurs can readily absorb a large amount of war surplus stock without affecting adversely the economy of the radio industry. Finally, most amateurs who can afford the best, will prefer purchasing apparatus designed specifically for their needs.

On the other hand, the immediate release

[*Continued on page 56*]

Still Your BEST CHOICE for ALL INPUTS...ON ALL BANDS!

TAYLOR TUBES



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In rectifiers, the 866 Jr. and 866A are the standard of comparison...more in use than all other makes combined.

The TZ-40 has been the leader in the medium power field for 8 years...it's still the tops in performance and value for both Class C RF and Class B Audio. Proof can be heard on the air daily.

The "Tuffy" TUF-20 has set a new standard in the portable-mobile field—a tube that can take it and put it out!

The new Taylor TB-35 Beam Tetrode has quickly established itself as a most popular type for ease of drive and for band-change rigs.

That's just high-lighting a few of the famous Taylor Tubes. Others—the T-55—the T-200 and the T-125—the T-20 and TZ-20—the 805 and 203Z and the big 822 are again enjoying deserved popularity.

Most Hams know that they are safer with Taylor Tubes because they are protected by the generous Taylor Guarantee.

SOLD BY ALL LEADING RADIO PARTS DISTRIBUTORS

"MORE WATTS PER DOLLAR"

ALL AMATEUR TRANSMITTER CONTEST

For the best interests of all Amateurs, the contest closing date has been extended to May 15, 1946. You can still secure your entry blank at your radio parts distributor or by writing directly to Taylor Tubes, Inc.

Taylor HEAVY CUSTOM BUILT DUTY Tubes

TAYLOR TUBES INC., 2312-18 WABANSIA AVE., CHICAGO 47, ILL.

NARROW BAND FM

For Amateur Use

JACK BABKES, W2GDG

FM has a definite place in ham radio. This is the first in a series of articles discussing the practical aspects of FM. Every phase will be covered, including transmitters and modulators that will convince even the most skeptical amateur that FM is here to stay

WHILE COMMERCIAL broadcasting has been making increased use of F.M., there has been no corresponding development in the amateur field. F.M. advantages over A.M. broadcasting are so great that its limited utilization by amateurs is difficult to understand without an appreciation of the causes for this condition. The foremost obstacles to wider adaptation of this superior method of transmission appears to be the misconception that F.M. equipment is expensive and extremely complex.

Those pioneering amateurs who have tried F.M. were discouraged when they found it difficult to maintain communications with stations having the conventional A.M. receivers. The elimination of this trouble would have been relatively simple if they had used narrow band F.M., instead of wide band F.M. Using narrow band F.M., not only could they communicate with stations having A.M. receivers, but would have been able to penetrate practically all types of QRM with greater ease.

Narrow Band FM

The definition of narrow band F.M. is a deviation of unity or a modulation index of 1. (When the modulation index equals unity, the variation of radio frequency from the frequency of the carrier is equal to the modulation frequency.) As we are interested mainly in voice frequencies between 300 and 3000 cycles, the use of narrow band F.M. makes it possible and practical to employ a standard A.M. receiver since deviation at the transmitter is only 3 kc or a total bandwidth of 6 kc.

For sheer economy F.M. leads the field. It

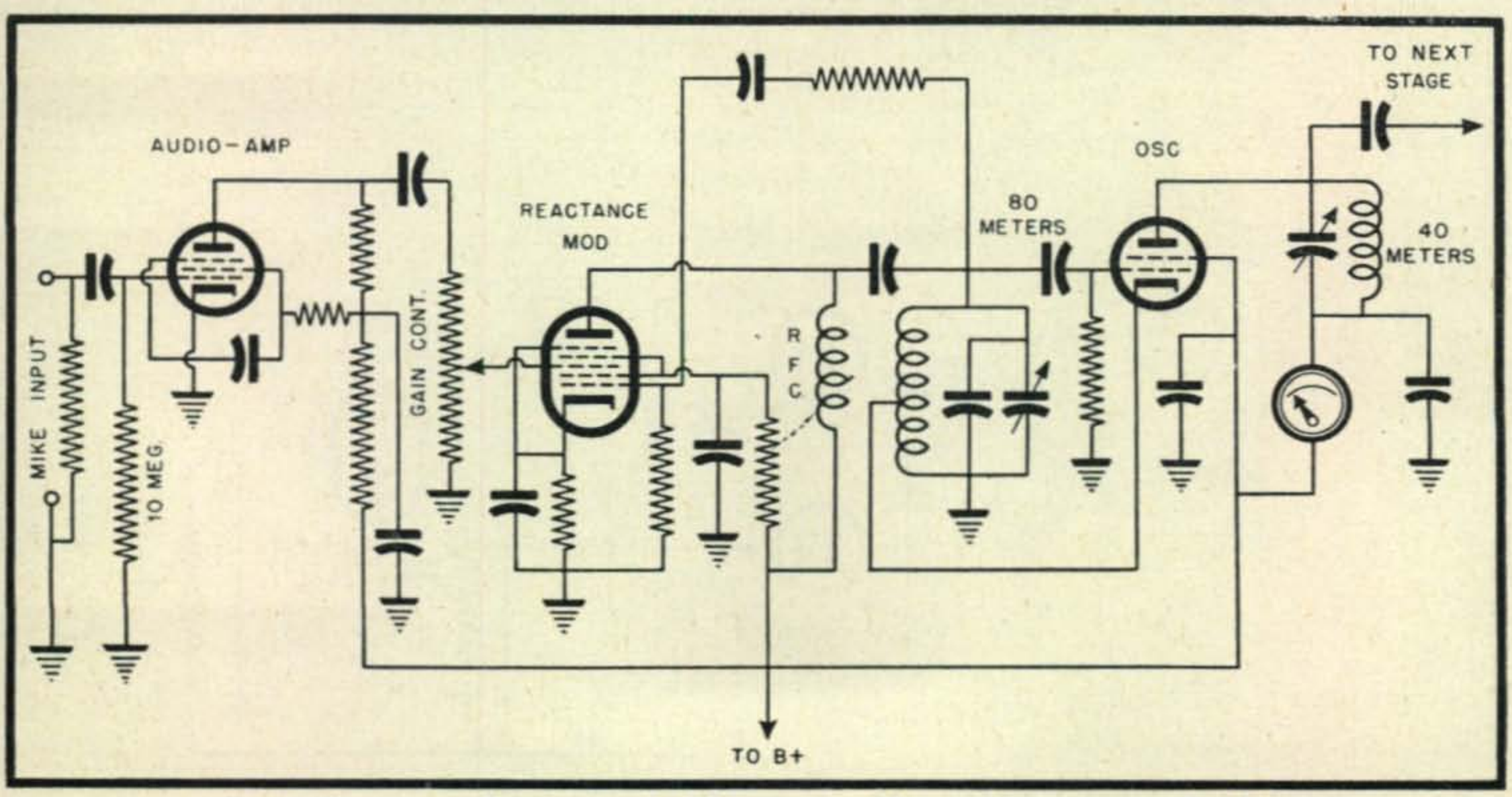


Fig. 1. Conventional reactance modulator and oscillator with one stage of audio

guarantees a savings of at least 60% over the present day A.M. transmitters. For example, let us assume that we have built an A.M. phone transmitter for ten meter operation and are using an 813 tube for the final. In order to modulate the final 100% for 175 watts output 87.5 watts of audio is needed. In narrow band F.M. modulation only two small receiving tubes are required to obtain 260 watts output from the same 813 tubes. The following features of narrow band F.M. should be emphasized.

A. A conventional A.M. receiver can be used with excellent results.
B. Any narrow band F.M. transmitter is more economical in construction than an A.M. transmitter of similar performance.
C. Narrow band F.M. has a better signal to noise ratio—approximately 6 db—making it possible to get and maintain better DX contacts.
D. More watts per dollar and greater efficiency is obtained from narrow band F.M.

FM on an AM Receiver

When using a conventional A.M. receiver, all you have to do is turn off the automatic volume control and detune the receiver to either side of its carrier. In actual practice it has been found that receivers having a variable bandwidth control operated best when set in either the medium or broad position corresponding to a band pass of from 6 to 10 kc. Some of the inexpensive receivers have a fixed IF system which corresponds to a 6 to 8 kc band-pass, which is adequate for reception of narrow band transmissions. By using this method of reception the second detector becomes a "slope detector," receiving the F.M. signal and converting it back to A.M. When QRM is present and the "going gets tough," the receiving station has the advantage of being able to tune his receiver to the other side of the F.M. carrier, making it possible to maintain a better QSO. This procedure gives the receiving station a choice of two frequencies . . . . yet the narrow band F.M. transmitter doesn't occupy much more room in the receiving spectrum than a conventional A.M. transmitter. When comparing a weak F.M. signal of approximately R-3 to a fair A.M. signal of R-6, it will be observed that the F.M. signal will always be easier to copy. Practically all QRM is A.M., enabling the F.M. signal to penetrate through, providing the QRM is of equal signal strength to that of the F.M. If this

[*Continued on page 61*]

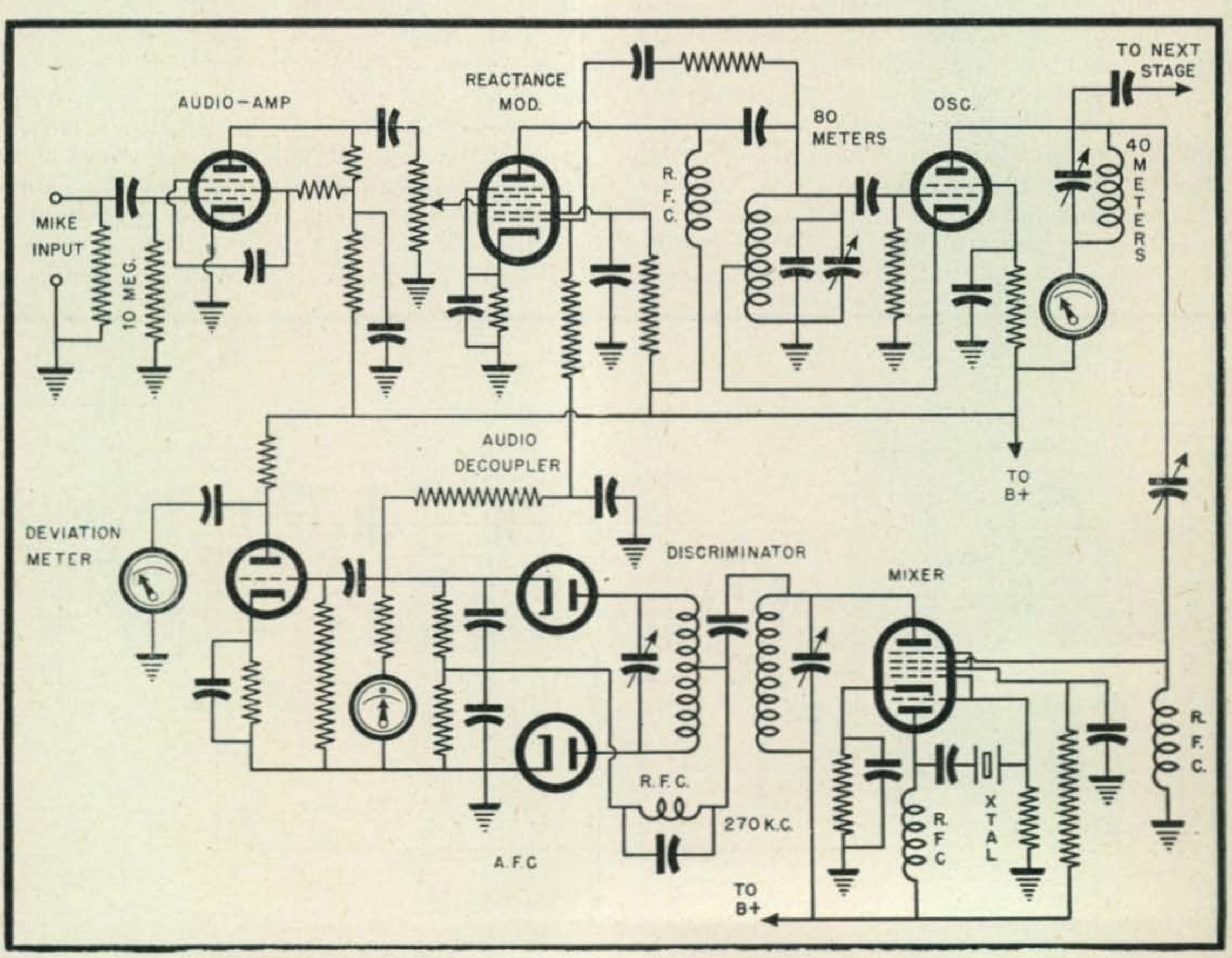


Fig. 2. Automatic frequency control network to maintain frequency control in FM

Constructing The

8 JK BEAM

The most difficult part in constructing the highly effective 8JK beam antenna is the mechanical support. This thorough description of a simple and easy method of construction will be of interest to newcomers and oldtimers alike

DAVID F. LEWIS, W2IYO

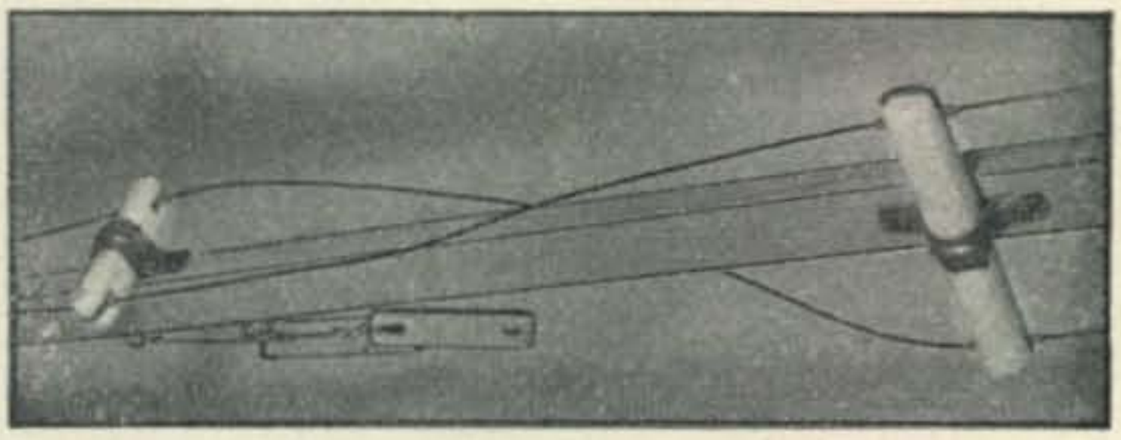
WITH THE OPENING of all bands envisioned in the near future, amateurs are again faced with the problem of efficient antennas. Undoubtedly many amateurs have changed their QRA during the war or have disassembled antenna systems, necessitating new installations. In the past, much emphasis was placed upon the importance of a properly designed radiator from an electrical standpoint, but relatively little consideration was given to correct mechanical construction. War-time engineering and manufacturing have accentuated the importance of rugged mechanical and efficient electrical design—actual experience revealing that one without the other will not suffice. It was with this in mind that the following antenna system and method of installation came into being.

Ten and Twenty Meters

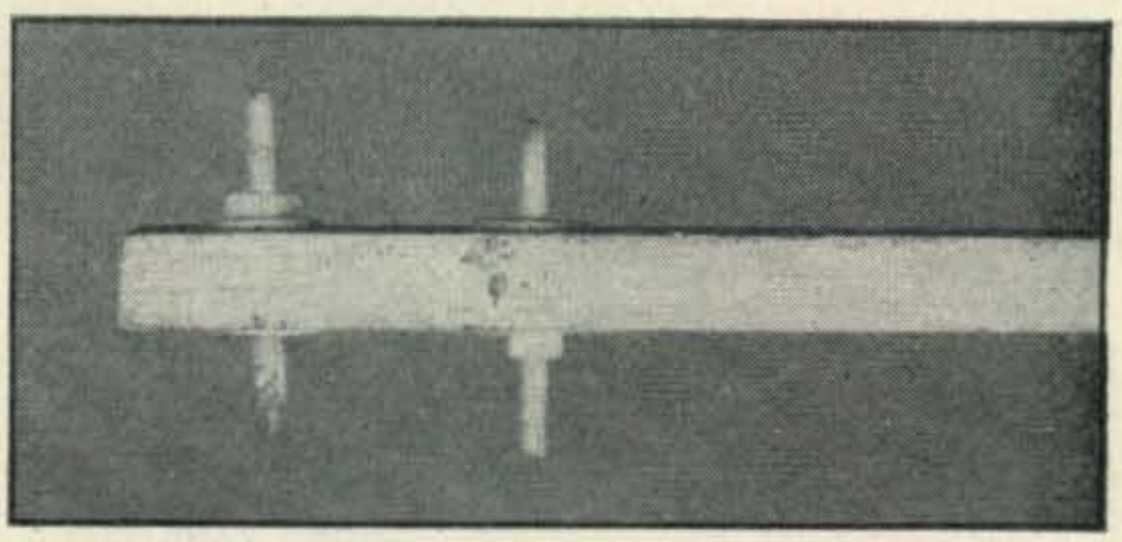
Operation was desired on the twenty and ten-meter bands, and a beam was designed that would give satisfactory operation on both spectra. As only limited space was available, the antenna system had to be as small as possible, exhibit maximum efficiency, and be mechanically rugged. A bi-directional end-fire array—known in amateur circles as the "Kraus flat-top or 8 JK Beam," was selected (*Fig. 1*). As this system is fully described in most amateur hand books only a brief resumé of its electrical characteristics will be given here.

Essentially, this antenna consists of two dipoles closely spaced. It is possible, because of the close spacing, to obtain proper phase relationship by crossing the wires of the flat-top at the voltage loops rather than utilizing phasing stubs. The bi-directional gain of this array is 6 db on its fundamental frequency. It can also be used on the second and fourth harmonics with a tuned

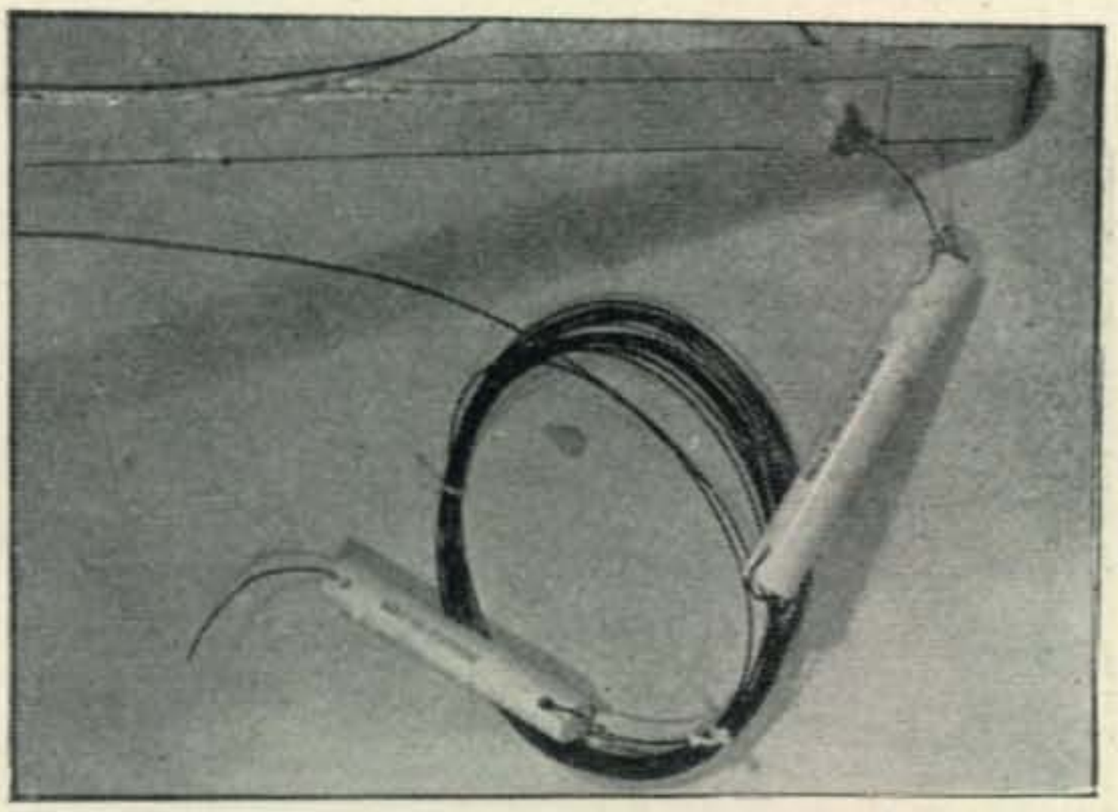
[*Photos by Jack Gelblicht*]



Photographic description of the cross-over and suspension insulators. Sponge rubber cushions the insulators from the straps



Eye bolt arrangement on both ends of all three wooden spreaders



Method of fastening antenna to eye bolts. Note that the insulator separates the antenna wire from the bolt itself

open-wire line. When operating on harmonics, the radiation pattern has four main lobes. If only twenty-meter operation is desired, a matching stub may be employed to obtain the proper impedance match between an open-wire line of 600 ohms impedance and the flat-top. This will allow the use of an untuned line of any desired length with negligible losses if the standing-wave ratio is kept to a minimum.

Constructional Data

In order that the finished product be mechanically rugged the best of materials should be used in its construction. The following lists the materials and tools necessary to complete the job.

Materials

12 staple plates, 2″ x 2″ with 1/8″ staple loops, 4 mounting holes. Brass or galvanized steel.
2 pipe-straps, two-hole mounting type for clamping 1″-diameter pipe. Brass, copper or galvanized steel.
24 8-32 x 1½″ round-head machine screws, —nickel-plated brass.
24 8-32 x 5/16″ hex nuts, nickel-plated brass.
24 8-32 split lock-washers.
4 1″ round-head wood screws, nickel-plated brass.
9 7″ glazed-porcelain insulators, 1″ diameter, 800 lbs. break-strength.
4 4″ glazed-porcelain insulators, 1″ diameter.
200 ft. of #12 steel core, copperclad, enamel-covered wire.
2 eye-screws, ½″-diameter eye.
3 lengths seasoned oak 2″ x 1″ x 9′.

Tools

1 large pair of cutters.
1 pair of mechanic's pliers.
1 hand drill with a #19 drill.
2 sheets of moderately rough sandpaper (about #1 grit).
1 100-watt soldering iron.
Solder.
Screwdriver.

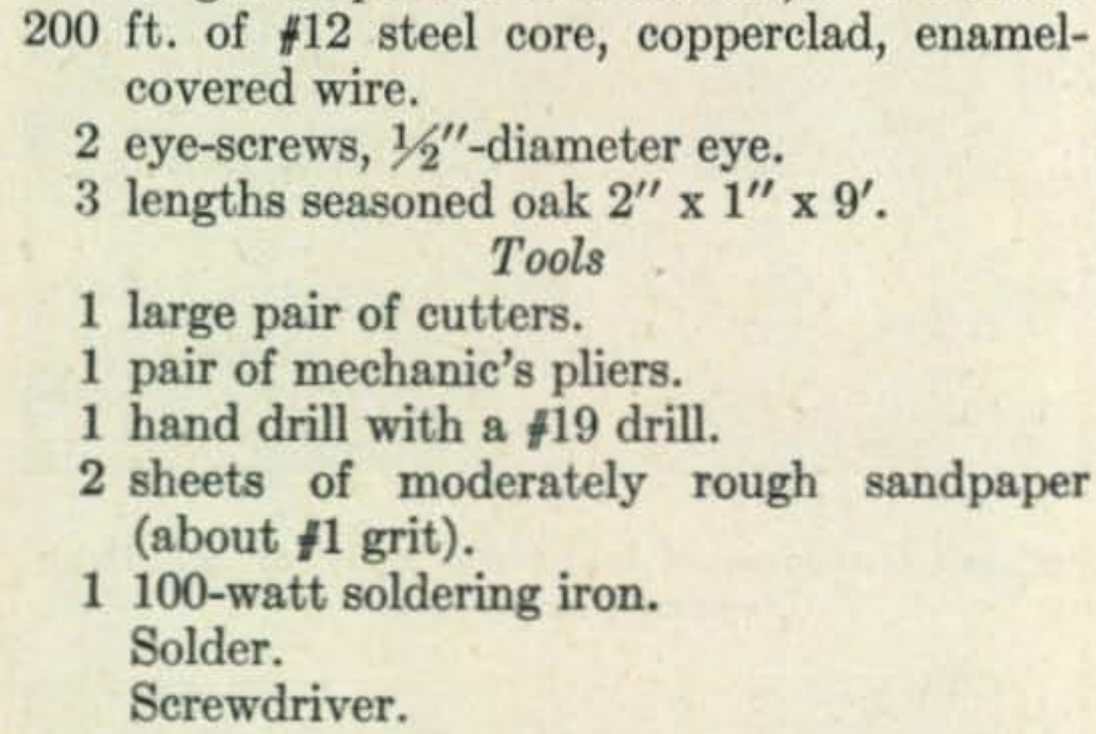


Fig. 1. Diagram of the 8JK beam. Feeders are attached to points X and X

The first step in constructing the array is to mount the staple plates on the two-inch side of the oak spreaders. Locate the plates with the staple in the vertical position exactly two inches from each end on the three nine-foot pieces of oak, and scribe the mounting holes with a pencil. Drill a hole with a #19 drill through the center of all scribed points. Next place a staple plate on each side of the oak spreader and insert the 1½″ machine screws through the four mounting holes (*Fig. 2*). Apply the lock-washers and hex nuts and draw up as tightly as possible with a screwdriver. The distance between the centers of the staple plates at each end of the oak spreader will be exactly 8′, 8″ (the desired spacing) if the staples are 2″ from each end before mounting. This spacing constitutes the necessary distance between the antenna dipoles.

At this point, it is advisable to apply a coat of varnish or paint to the oak lengths to protect them from the weather. Spar varnish is strongly recommended as its weather-resistant properties are excellent. If desired, two coats may be applied for longer protection.

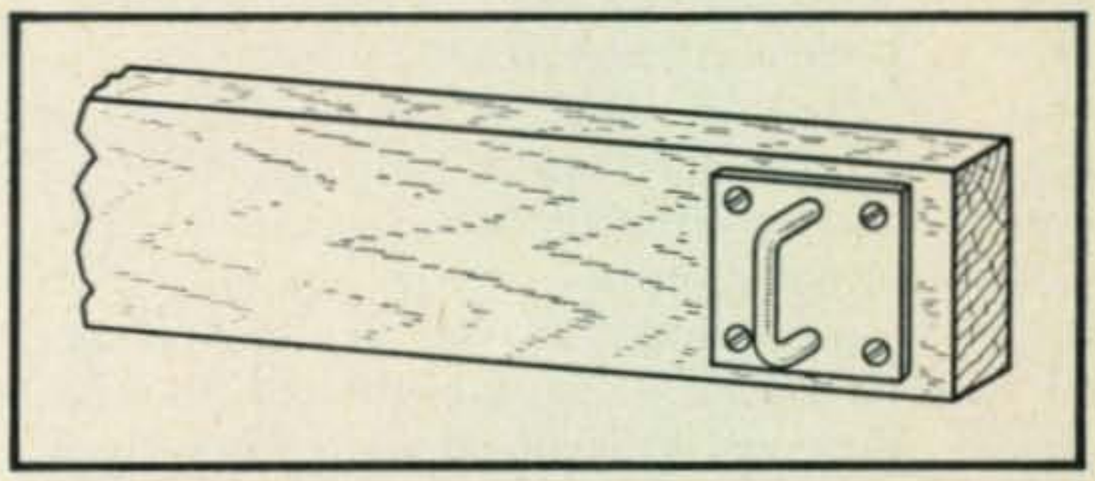


Fig. 2. Showing the staple plate mountings on the three 9-foot lengths of seasoned oak

The next step is to mount a 4″ insulator exactly in the center of one of the oak spreaders which will be the center spreader of the array. This insulator is used as a separator for the two dipole wires where they cross over for proper phasing (*Fig. 3*). It is at this point that the feeders or matching stub are connected. To mount the insulator, measure 4½′ from one end. Place the insulator horizontally at right angles to the spreader and against the 1″-side of the wood. Hold it there by placing one of the pipe-straps over the center of the insulator. Mount the strap with the 1″ wood screws. This will affix the insulator securely in a horizontal position. A small piece of sheet rubber 1/16″ thick may be placed between the clamp and the insulator before mounting the clamp. This will insure tight clamping action and also protect the procelain insulator against cracking when pressure is applied to the screws holding the clamp.

Two eye-screws are mounted directly beneath the insulator. The center-to-center spacing of the eye-screws must be 4″ and 2″ each side of the center insulator. These are used to suspend in-

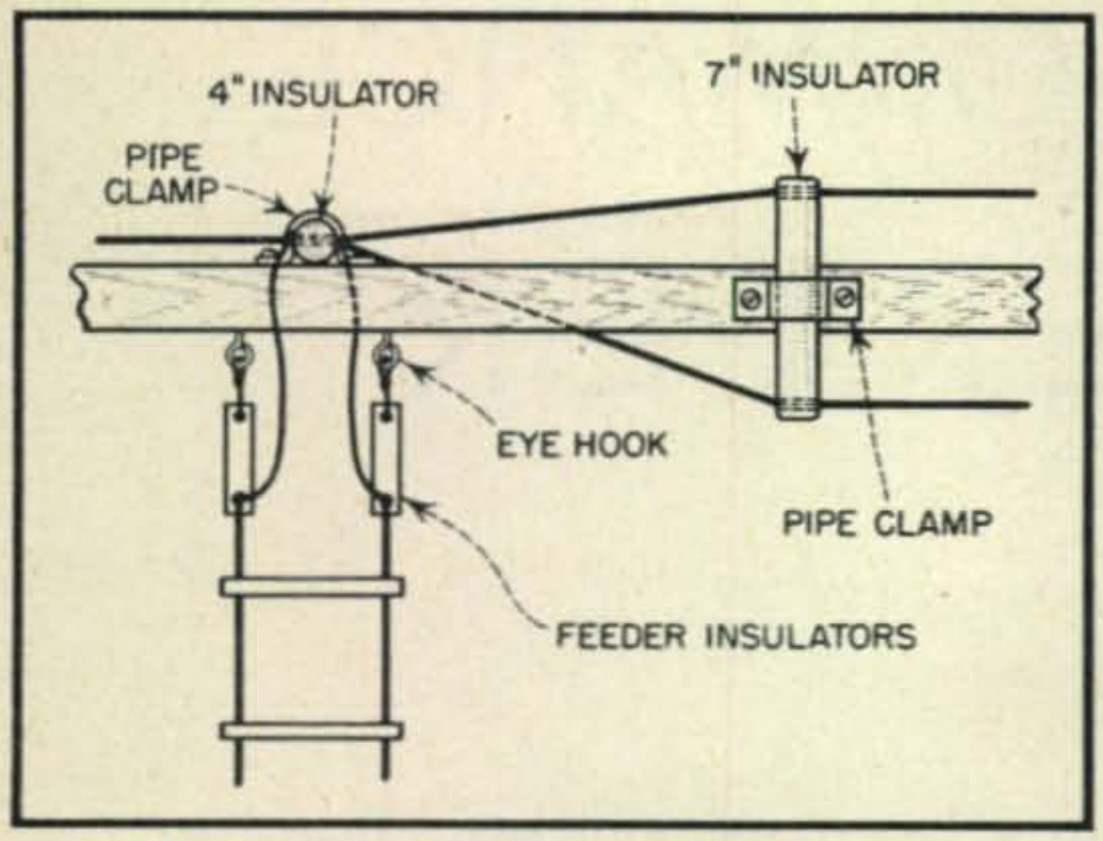


Fig. 3. Wiring detail explaining feeder support and connections

sulators which will support the open wire line or matching stub, if the latter is used. Mount a 7″ insulator against the 2″ side of the spreader in a vertical position two feet from one end of the spreader. The method of mounting is the same as described for the cross-over insulator. This insulator separates the dipole wires just before they cross over at the center insulator.

Dipole Wires

Measure and cut the #12 copperweld wire for the antenna dipoles. Looking at the antenna from the top in *Fig. 1*, it consists of two parallel wires that cross over at the center, forming a four-legged figure. The length of each dipole is 60′ plus 9′ for the cross-over or a total of 69′. This will make the length of L-1 exactly 30′ per leg. The overall length of the antenna is 60′ which is quite small for a beam capable of six db gain broadsides. The dimensions given will allow efficient operation on any frequency between 14000 and 14400 kc or on harmonics therefor.

Because #12 steel core wire is rather difficult to handle, the following method of measuring and cutting was used by the author. Fasten one end of the wire securely around a tree or post. Reel off about 32′ and fasten that end to the bumper of a car. Push the car slowly until the wire is taut and then apply the brake. This method will allow accurate measuring and cutting of the four 30′ and two 9′ lengths. When cutting allow sufficient excess for tying to the antenna insulators.

After the wires are cut, attach each end of the 30′ lengths to the eight remaining 7″ insulators. Remove the enamel coating with sandpaper for a distance equal to the excess length allowed for insulator tying. Slip the ends of the wires through the holes in the insulators and wrap around the antenna wire at least five times and solder. Make sure a good soldered connection is obtained. Attach one end of each wire to a staple plate on each of the two end oak spreaders. Use #12 copperweld as the tie wire between the insulators and the staple plates. Next fasten the free ends of the four wires to the center oak spreader. The length of the tie wires between the insulators and the staple plates should be exactly 4 inches. This will allow a distance of two feet (lengthwise) between the L-1 legs. Now that all four lengths are attached to the three spreaders, the cross-wires are attached. Sandpaper the ends of the two 9′-lengths of wire. Wrap around and solder one end to L-1 where it is fastened to the insulator at the center spreader end. Slip the free end through the upper hole of the separator insulator, through one hole of the center insulator and out to the diagonal leg of the antenna and solder securely. Repeat this operation with the other 9′ length using the remaining two legs, L-1, and the remaining holes in the spreader and center insulators. The cross-over wires may be attached to

[*Continued on page 63*]

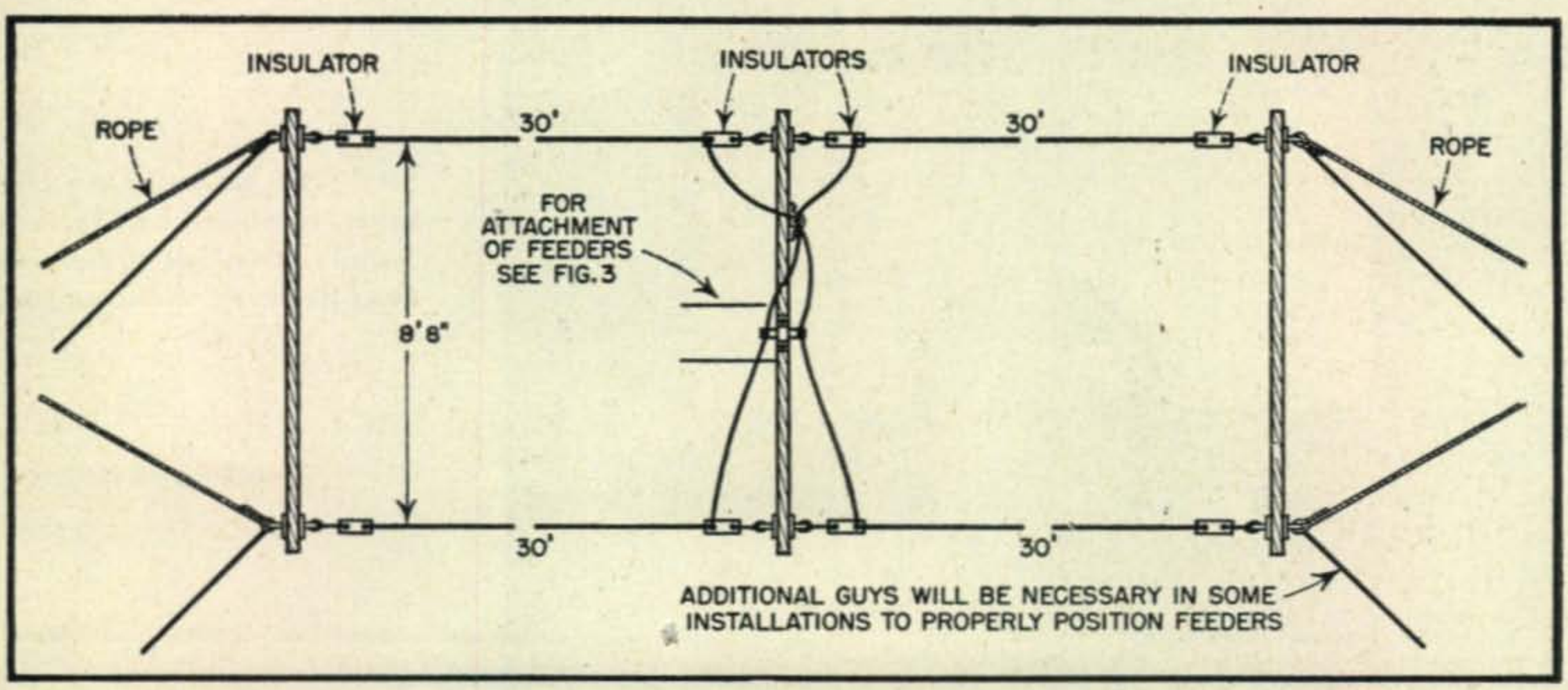


Fig. 4. Sketch of the completed array showing spreaders, cross-overs, antenna, supporting tops and guys

HIGH PERFORMANCE CONVERTER

HOWARD A. BOWMAN, W6QIR

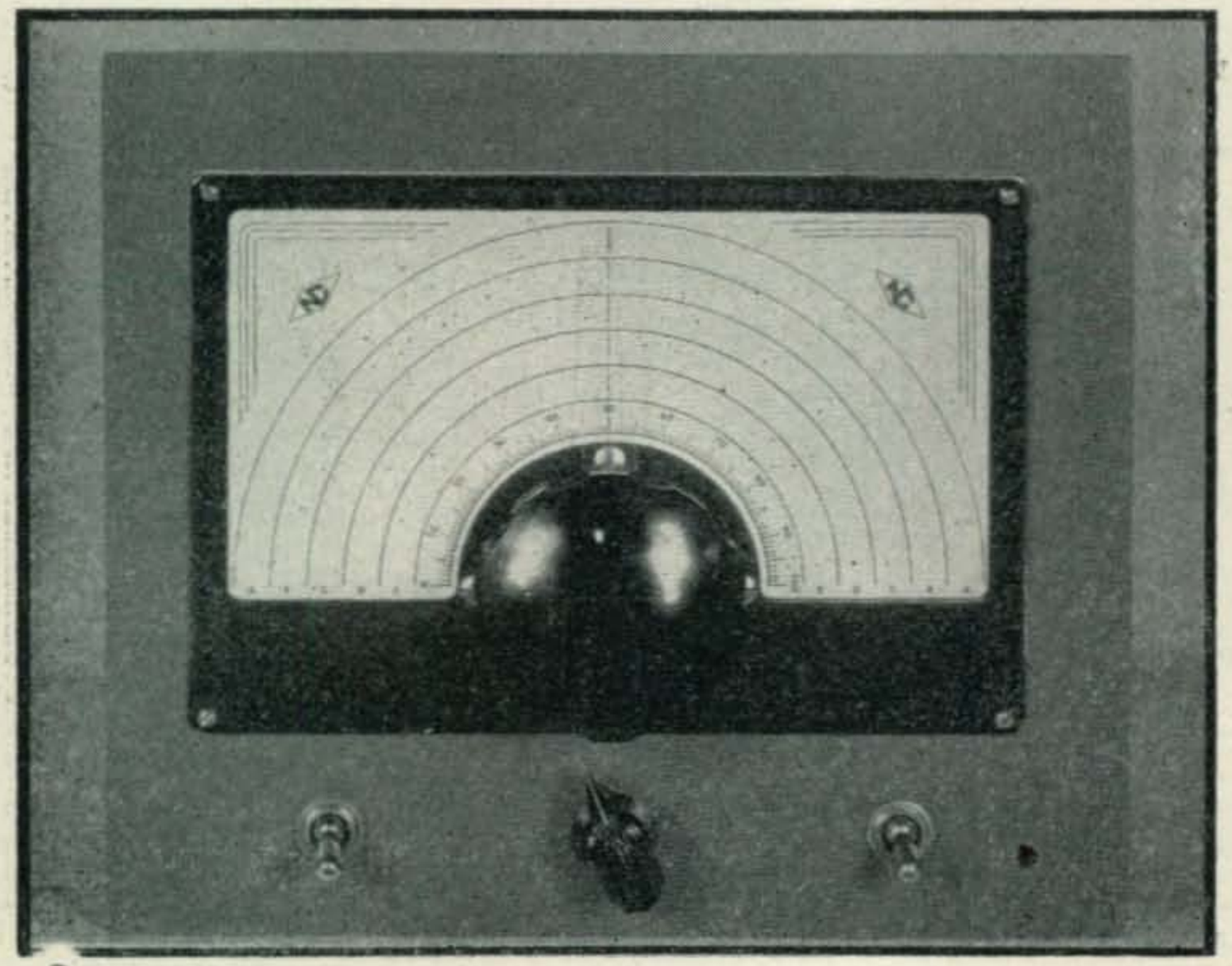
This straightfoward converter may be used on any number of bands with plug in coils. Complete details of construction are covered, making it a project ideal for the non-engineer ham. 10 meter DX is rolling in at W6QIR with the aid of this high performance unit

AWAY BACK "Befo' de wa'" when first on ten meters, we were aglow with expectations of some of this fine DX heard being worked in another fellow's shack. The shack was rude, and the awakening thorough. We just didn't hear it. And it's an old truism in Ham ranks that if you can't hear them you can't work them.

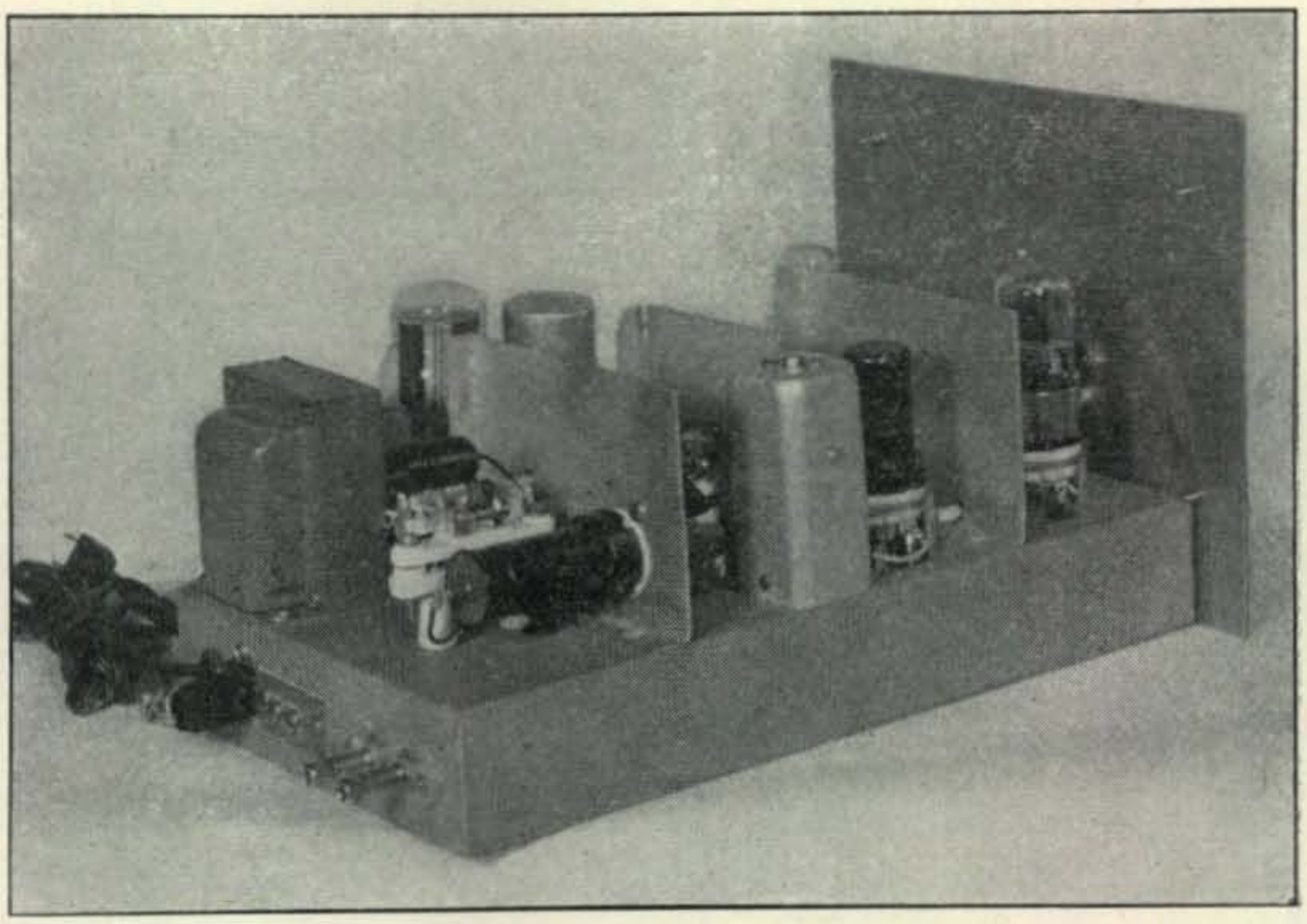
At first the inclination was to suspect antenna trouble, but a switch to a three element rotary didn't help too much. There was the gain to be expected normally from such an array, but the receiver still wasn't performing nearly as well as many others (of greater cost, it's true) that were heard elsewhere.

Following the manufacturer's instructions for such a procedure, a 0-1 Ma. meter to serve as a carrier strength indicator was connected to the receiver. We had long been aware that to get any kind of results from the receiver on ten we had to leave both r-f and a-f gain controls wide open. The meter was a revelation. On the lower frequency bands it performed as would be expected. A signal that sounded R8, read R8 on the meter. On the receiver's highest frequency range, however, it was a different story.

Signals which we would have classified R6 to R8 (by ear) produced virtually no meter deflection. Local signals which seemed about to tear the cone from the speaker pushed the needle up to R3 or R4.



Single dial tuning of the converter simplifies operation. Switches from left to right are Send-Receive, Antenna, and AC On-Off



Connectors on back of converter are a-c line, Jones connector for external control, terminal strip for connecting to receiver, and antenna binding posts. Note r-f grid coil assembly. Other coils are similarly made

The inference we drew from this experience was simply that the receiver did not have the necessary amount of gain on its highest frequency range. Investigation showed the front end L-C ratio to be poor for such work. The capacitors were large and the inductances small. It was obvious that more r-f gain was needed.

When an 1853 failed to produce noticeable change when substituted for the 6SK7 r-f tube, it was decided to try a converter ahead of the receiver, a procedure long advocated by the ardent ten meter hounds with whom we had become acquainted.

The first converter was a simple one, consisting of a 6K8 oscillator-mixer combination, preceded by a 7G7/1232 r-f stage. Both grid and plate circuits of the r-f stage were tuned, producing a considerable amount of gain. The performance of the converter as a whole was a revelation. Even though tuning was done through the oscillator section alone, the r-f stage merely being peaked on the signal, signals were up noticeably. The gain amounted to several R points on the meter, and we could now back down the a-f gain and eliminate some of the noise. The combination of converter and receiver seemed to us then, and seems to us now, better than any receiver we have heard operating straight through at these frequencies.

With the war and WERS, the converter was torn down for its parts. Now, with ten open again, and in fairly good shape, the time has come to pay attention once again to converter design.

In the past few years thinking over converter design, we have come to be rather definite about the things which should go toward making a good converter. We even listed them so that they could be checked off in building. Here they are:

1. Voltage stabilization on the oscillator at least, and perhaps elsewhere too.
2. Separate oscillator and mixer tubes. The various converter tubes are good, but at these frequencies, not quite good enough.
3. All the *usable* gain we could get.
4. Provision for antenna switching, so that the converter might be left permanently connected to the receiver.
5. Single tuning control.
6. Multi-band operation.

All of these we achieved. Some of them were accomplished only at the expense of other items, but the finished converter is satisfactory from the standpoint of any of the above criteria.

Choice of Tubes

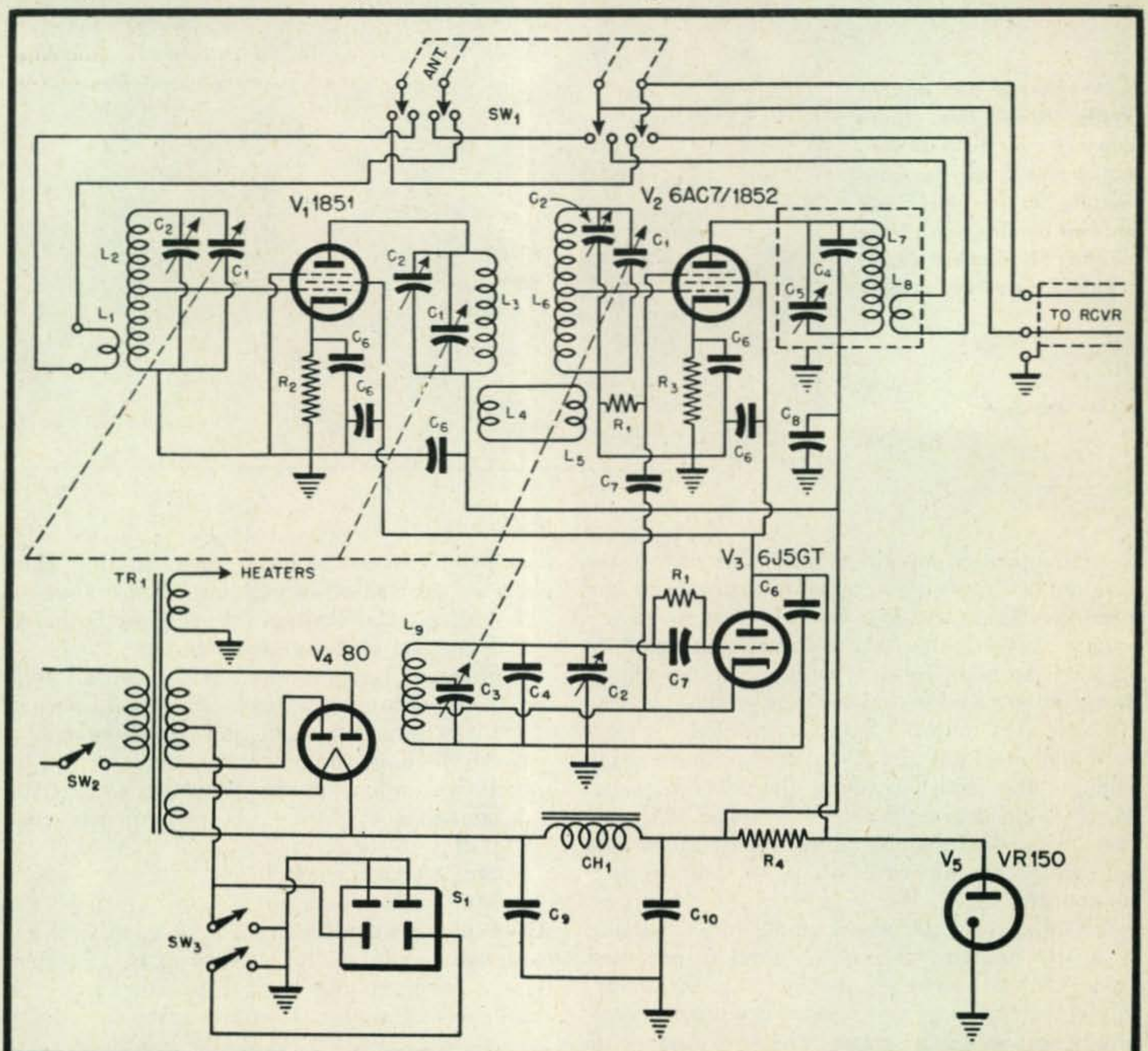
Obviously, the first chore was to select tube complement, because upon these selections many other points might hinge. They would to some extent determine chassis layout, and most certainly would have effect upon the circuit design.

The oscillator tube was the easiest to choose. The 6J5 is a ready oscillator in almost any circuit, and operates well at frequencies much higher than were contemplated working with the converter. In addition, the fact that it is a triode makes the circuit considerably simpler than would have been the case had a pentode been chosen.

For the mixer we chose a 6AC7/1852. The 1852 has a very high transconductance when used in mixer service, and will give much greater conversion gain than any of the usual mixers or converters. It has full shielding, and its metal con-

struction means that physically it is very sturdy.

The r-f stage presented quite a problem. Since it was desired to tune both input and output circuits, some means of isolating these from each other was a necessity to prevent oscillation. We didn't want even a trace of instability which is almost invariably accompanied by inaccuracy in tuning reset. It is evident that one of the best



Wiring diagram of 10 to 2 meter converter constructed with the following parts—(others of equivalent performance may be substituted)

C_1—10 $\mu\mu f$ double spaced Bud "Tiny Mite" (or equivalent)
C_2—3-30 $\mu\mu f$ mica trimmer
C_3—15 $\mu\mu f$ Bud "Tiny Mite" (or equivalent)
C_4—50 $\mu\mu f$ zero temperature coefficient ceramic
C_5—35 $\mu\mu f$ Bud "Tiny Mite" (or equivalent)
C_6—.005 mica
C_7—.0001 ceramic
C_8—.01 paper
C_9, C_{10}—10 μf, 450 volt electrolytic
R_1—60,000 ohms ½ watt
R_2—300 ohms ½ watt
R_3—300 ohms ½ watt
R_4—6,000 ohms 10 watt
Tr_1—Power transformer—must deliver 250-300 v at 30 ma, minimum plus 5 v, 2 amps for rectifier, and 6.3 v, 2 amps for tube heaters
Ch_1—20 henry 50 ma
Sw_1—4 PDT ceramic rotary switch
Sw_2—SPST toggle switch
Sw_3—DPDT toggle switch
S_1—4 prong female connector for joining receiver and converter power supplies
L_1—8 turns #14E, ¼" dia. close-wound, inside L2 at ground end
L_2, L_3, L_6—13 turns #14E, ½" dia. L_2 and L_6 tapped 9 turns from ground end
L_4, L_5—5 turns #14E, ¼" dia. close-wound, inside L_3 and L_6 at "cold" ends
L_7—35 turns #24E, ¾" dia. on polystyrene rod, close-wound
L_8—10 turns at cold end of L_7, about ⅛" separation
L_9—5 turns #12E, spread to 1¼" long by ½" dia. Cathode tap 1 turn from ground end, and band-spread tap about 1½ turns from grid end
V_1—1851
V_2—6AC7/1852
V_3—6J5GT
V_4—80
V_5—VR-150

and simplest ways of achieving this isolation is through the use of a double-ended tube, so-called because the grid lead comes out through a top cap, while the balance of the leads are through the usual prongs on the base.

Of such tubes, only two choices presented themselves, the 1851, and the acorn 954 or 956. While the acorn would be ideal from a physical (mounting) standpoint, as well as electrically, it is somewhat fragile, and previous experiments delineated in the literature on the subject seem to indicate that it is little better than the 1851 at these frequencies.

It might be well to point out at this stage that the 1852 might also be used in this service if the socket mounting were so oriented as to place the grid prong next to the shield between grid and plate tuning circuits, and if some effective means were employed to shield this base prong from all others on the socket.

Circuit Design

The circuit is designed to have as much gain as possible, consistent with non-regenerative operation and the adjustments and compromises necessary to achieve single dial control.

The r-f stage is tuned in both plate and grid circuits. The antenna is coupled to the ground end of the grid coil, and the antenna coil consists of a small inductance, one-half the diameter of the grid coil, which is mounted inside the grid coil coaxially with it.

The plate coil is an identical structure, with two exceptions. In order to reduce loading on the 1851 grid, and thus retain a higher "Q," the tube grid is tapped down on the coil. This is not true of the plate circuit. The other exception lies in the use of the small coaxially wound coil. In the plate circuit it is employed as a link to the grid coil of the 1852 mixer, and has fewer turns than does the antenna coil. Otherwise the two coils are identical.

The 1852 grid coil is exactly the same as the 1851 plate coil, except that it too has a tap for the grid connection.

All three of these coils are airwound, using National PB-16 forms or equivalent. Trimmer capacitors are 3-30 $\mu\mu$f mica compression type variables soldered directly across the coil terminals on the forms. They are thus adjusted for the coil. When a coil for a different band is plugged in, all necessary capacity changes are thus made automatically, and it is not necessary to recalibrate the dial.

The PB-16 bases, with their associated XB-16 sockets lend themselves admirably to this sort of work, although they are primarily intended for low-powered transmitter work. They come supplied with five terminals, each of which has a soldering lug attached. Two of the terminals have in addition a short hexagonal stud, intended for use in mounting the inductance itself. It is necessary to shift one of these studs so that the coil will be mounted on a 1¼ inch space. In each case the coil is mounted by inserting the ends of the wire into the studs and flowing in solder. The 3-30 trimmers are soldered to the lugs on these terminals, and are adjusted from across the chassis with a long handled screwdriver, preferably insulated.

One of the limitations we encountered came as a result of the fact that the coil bases have five terminals whereas six could have been preferred. We wanted to use tapped-coil bandspread, which would have permitted circuits of even greater "Q" and still would have allowed us to spread each band out across the entire span of the dial.

Without having six contacts on the coil the idea was discarded and the tuning capacity placed across the entire coil. This meant that good tracking with the amount of bandspread desired was secured only by making the inductance a bit smaller and the capacity a bit larger than hoped for. In spite of this, the coils are still several times as large as any seen in receivers of commercial manufacture.

Because we have been unable, at this writing, to buy additional PB-16 bases, only the ten meter coils have been wound. Obviously, twenty and fifteen meter operation is going to mean additional trimming capacity, and it appears from our calculations that on these bands it may be necessary to rearrange the orientation of the coil to its base in order to permit the tuning condenser to work off the grid tap on the coil.

The oscillator coil is also wound on a PB-16 base. The circuit is a grounded-plate Hartley, and is made quite high-C. The 3-30 $\mu\mu$f mica capacitor is paralleled by a 50 $\mu\mu$f zero temperature coefficient ceramic capacitor, and the actual capacity in use is about 70 $\mu\mu$f, plus tube and circuit capacities. To enable adjustment of the bandspread, the tuning condenser is tapped down on the coil.

Oscillator voltage is taken off the cathode and coupled to the mixer suppressor by means of a 100 $\mu\mu$f ceramic capacitor. The suppressor is biased by means of a 60,000 ohm resistor to ground.

One unusual feature of the circuit is the link coupling between the r-f amplifier plate circuit and the mixer grid. Suggested to us by W6REE, it has been used extensively, and is a fool-proof method of getting the signal into the mixer grid without excessive loading of the circuit or detuning effects.

The oscillator plate circuit as well as the

screens of the amplifier and mixer are fed from the 150 volt source, regulated by a VR 150. The pentode plates are fed from the full three hundred volts of the power supply.

One of the gadgets we like is the antenna switch. Since the station receiver must often be switched to other bands for a quick check on harmonics or spurious radiation (not ours), it is desirable to be able to do it with a minimum of difficulty. Ordinarily this would mean disconnecting the converter and connecting the antenna to the receiver. With the ceramic rotary switch provided, the antenna may be automatically bypassed around the converter and fed directly into the receiver input.

Since the purpose of the converter is to provide increased sensitivity two points are of particular importance. One is the design and construction of the converter itself. The other is the choice of a receiver frequency into which to operate the converter. The choice must be a compromise between a frequency at which the receiver has a high order of sensitivity, and a frequency of such magnitude as will cause images, if any, to fall outside the limits of the highest frequency band being worked.

Since the converter will also be used on 50-54 mc the conversion frequency must be greater than 2 megacylces. Actually a somewhat higher intermediate frequency was chosen, and the converter is at present feeding into the front end of the receiver tuned to 4.85 mc. The range of the output coil of the converter is approximately four to six megacycles, however, and by proper adjustment, the receiver may be operated anywhere within that range.

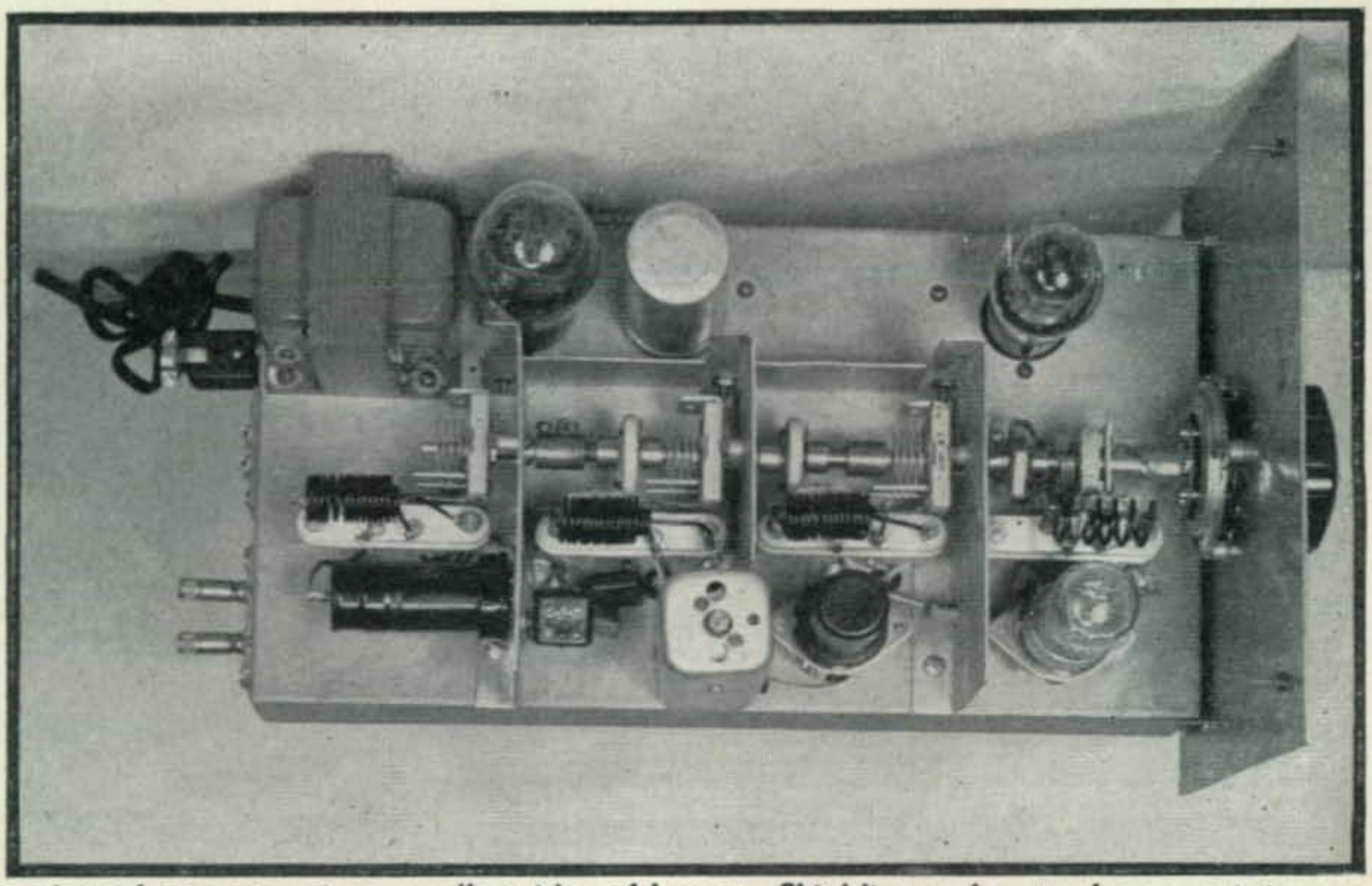
The converter oscillator is tuned approximately five megacycles higher than the mixer input, and the difference between these two frequencies is fed into the receiver input.

In connection with the receiver input frequency, the following may be of interest. We first operated into a frequency of 4.3 mc. For a couple of weeks of evening listening an unmodulated carrier of about R6 intensity, apparently at a frequency of approximately 28.5 mc was noted. Just on a hunch we grabbed a pencil and paper and began figuring. The receiver was set on 4.3 mc. The intermediate frequency of the receiver is 455 kc. This would put the receiver oscillator on a frequency of 4.755 mc. The sixth harmonic of this frequency is 28.530 mc. Simple, isn't it? We retuned the receiver and set the output of the converter to 4.85 mc and the signal vanished.

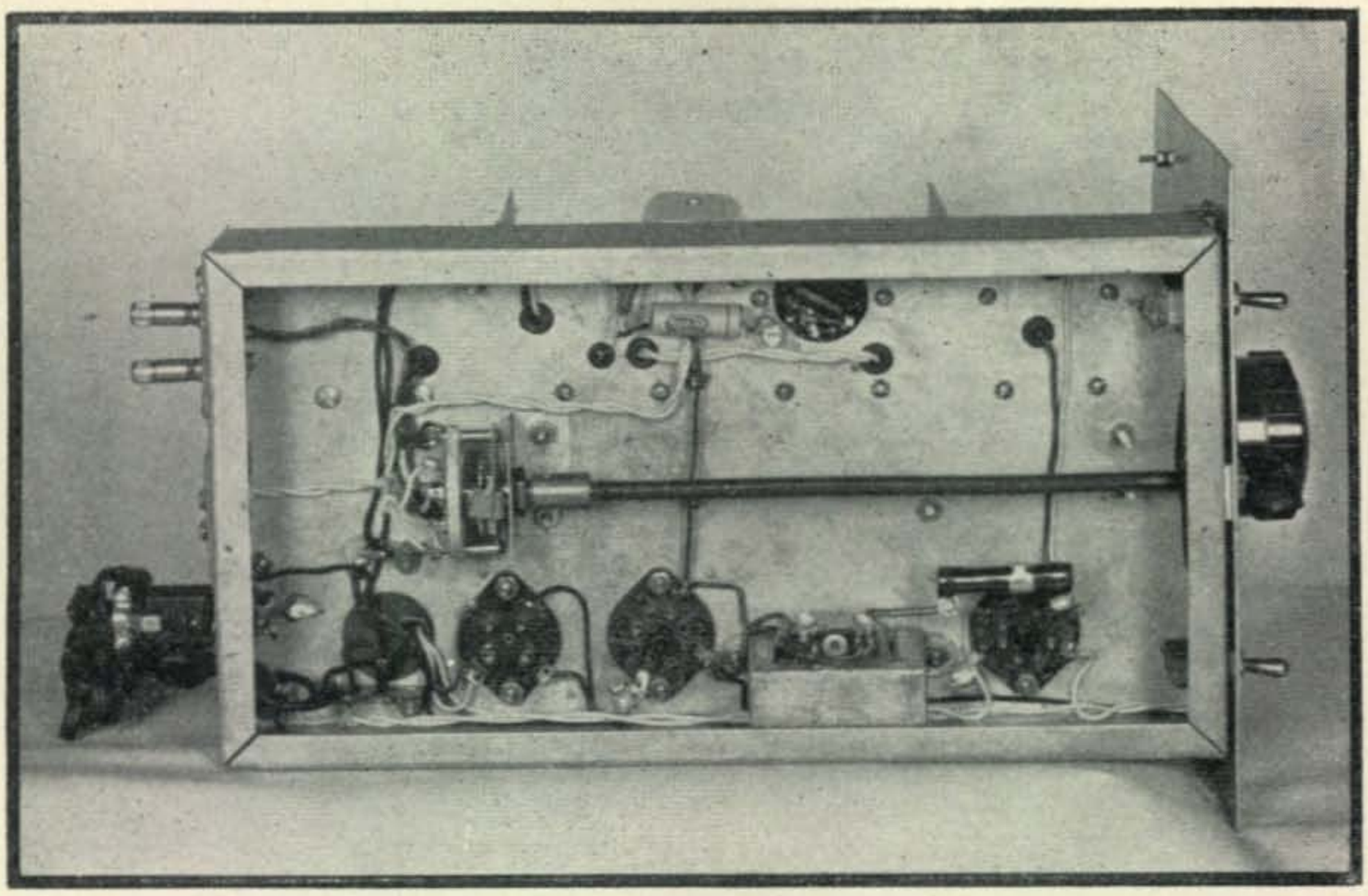
Mechanical Construction

Desiring a symmetrical arrangement of controls, a conventional layout was first tried—that is, with the dial in the center of a panel considerably wider than high. It was discovered that there just wasn't enough depth to the chassis to permit such an arrangement, so the chassis was turned to place the dial at one end, and the tuning capacitors were then strung out in a line, connected by an assortment of flexible couplings, solid couplings, shaft extensions, and so forth. If it were possible to work out an arrangement using dual- or triple- unit capacitors, much of this could be eliminated, but the arrangement of other parts might be restricted.

The several sections are separated by vertical



Top view of converter gives excellent idea of layout. Shielding and parts placement is important



Clearly visible in this bottom view are the transformer leads, rectifier socket, filter choke, and VR 150 socket. The rotary antenna switch is near the rear of chassis

baffle shields made of aluminum and bent over one-half inch at the bottom for fastening to the chassis with 6-32 machine screws. At one edge of each a lip was bent so that a stiffener piece might be screwed both to chassis and baffles. The tuning capacitors are mounted to the baffle shields by means of their mounting studs, holes being drilled oversize so that the condensers may be moved about to line their shafts up properly.

The oscillator section is at the front and nearest the dial so that its tuning capacitor will suffer least from any possible backlash which might develop. Next comes the mixer, than the r-f plate, last the r-f grid. All tuning capacitors come along the center-line of the 7″ x 13″ x 2″ chassis. Coil sockets mount between tuning capacitors and tube sockets so as to provide shortest possible leads.

The power supply occupies the righthand side of the chassis with the transformer at the rear. Since the converter will draw approximately 30 ma plate current, and 1.2 amperes heater current, a separate power supply is necessary, the average receiver supply being incapable of furnishing this power.

The filter choke is mounted below the chassis, and the filter condenser is a plug-in affair, mounting in a tube socket. The VR 150 is near the front of the chassis.

All tubes are mounted above the chassis. The 1852 and 6J5 are on bushings about 1″ long. With little wiring beneath the oscillator socket, we were able to get along by drilling and grommet lining a couple of ¼ inch holes in the chassis to pass heater and plate supply wiring. The 1852 has its associated bypasses lying across the socket, so a hole was punched beneath the socket to clear these. These capacitors project slightly through the chassis, and the various power leads come through the same hole. Since quarters are close in this stage, most wiring is done before assembly. The injection coupling capacitor passes through a 3/8″ hole in the shield between oscillator and mixer.

The 1851 is mounted horizontally, its socket screwed to the baffle shield separating plate and grid circuits. Supply wiring comes through grommeted holes in the chassis immediately below the socket. Here again much wiring is done before coil or tube socket is mounted. One unfortunate circumstance regarding the 1851 is that it is about one inch too long for the ideal layout. This makes both grid and grid return (ground) leads too long. The ground leads on the socket come to a soldering lug on one of the brass machine screws used to mount the socket to the aluminum baffle shield. On the other side of the shield, the grid returns are made to a heavy piece of tinned wire which grounds to a lug on the same screw. Although the grid return lead is nearly two inches long, there has been no trace of instability.

In the case of the 1852 and the 6J5, all ground connections from tube socket, coil socket and tuning capacitor are brought to a common point on the chassis. Leads are short and made of heavy tinned wire.

Grid clip for the 1851 is a clip taken from an old wafer type tube socket. Clips for the smaller pins on a six prong socket are just right.

[Continued on page 58

Improving
RECEIVER SELECTIVITY

COMMANDER E. H. CONKLIN, USNR, W3JUX

There are a number of ways to improve receiver selectivity without altering or changing the equipment now in use. Better performance from your receiver may be obtainable by reading carefully W3JUX's ideas

CONGESTION IN AMATEUR C.W. bands can be combatted by the use of tuned or peaked audio amplifiers. Signal Corps audio amplifiers from the last war were sold to amateurs who found them to be useful, following a regenerative detector. Subsequently, a Chicago concern brought out chokes tuned with condensers that could be used as interstage couplers in an 825-cycle peaked audio amplifier.

Although the band-pass audio system provided selectivity adequate to separate some of the adjacent-channel interference, it was later recognized when superheterodyne receivers began to be used by amateurs, that a large increase in the selectivity of the intermediate frequency amplifier would also produce a "single signal" effect. This improvement eliminated the audio image interference, making the amateur bands sound like there were only half as many signals

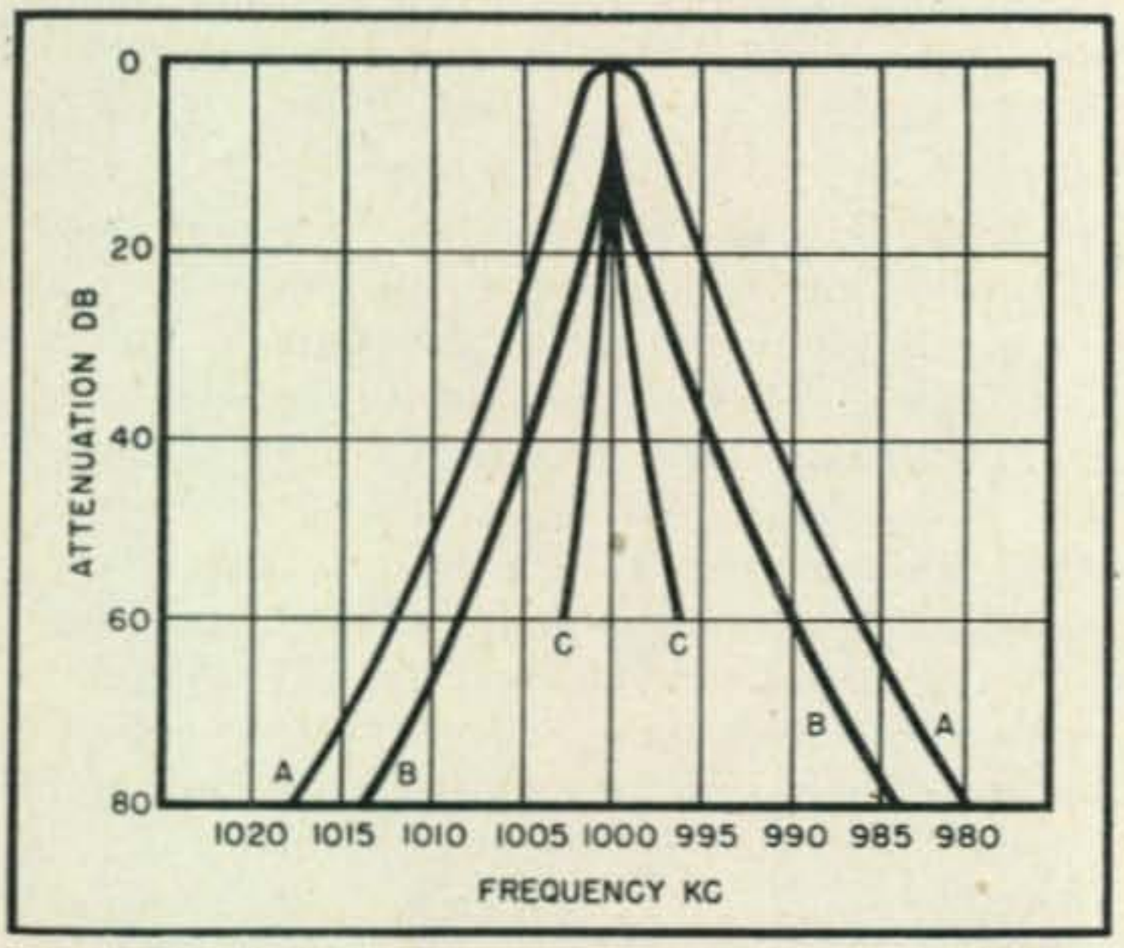


Fig. 1. RME Model 45 receiver selectivity at 1000 kc. Curve A-Crystal Filter switched off. Curve B-Crystal Filter set for broad operation. Curve C-Crystal Filter set for sharp operation

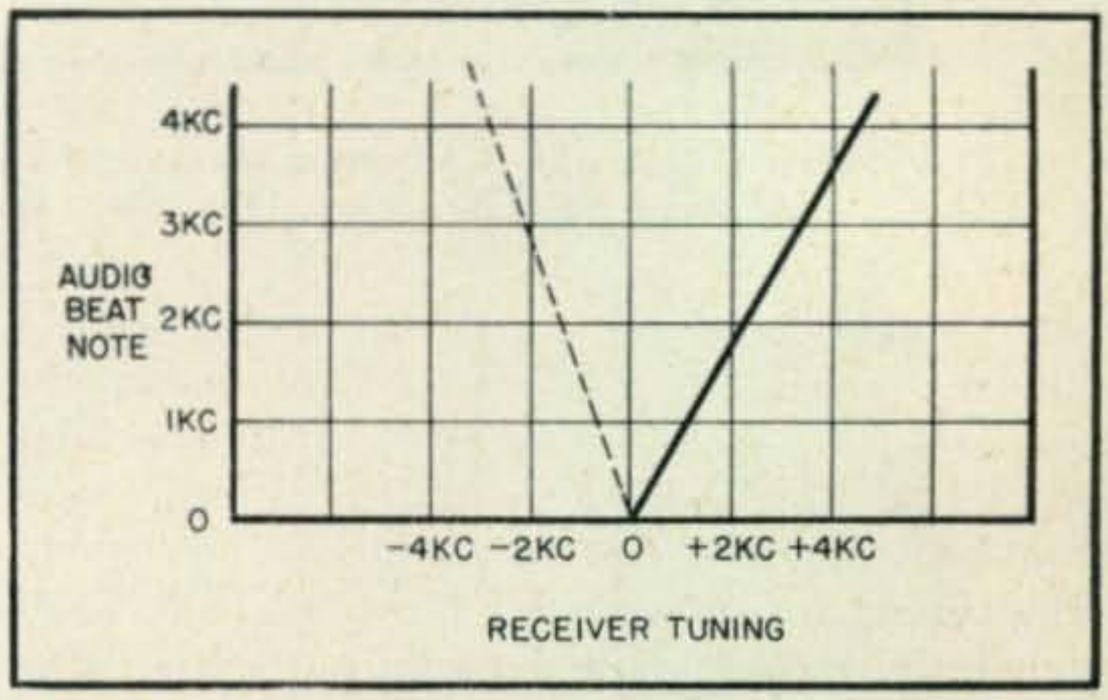
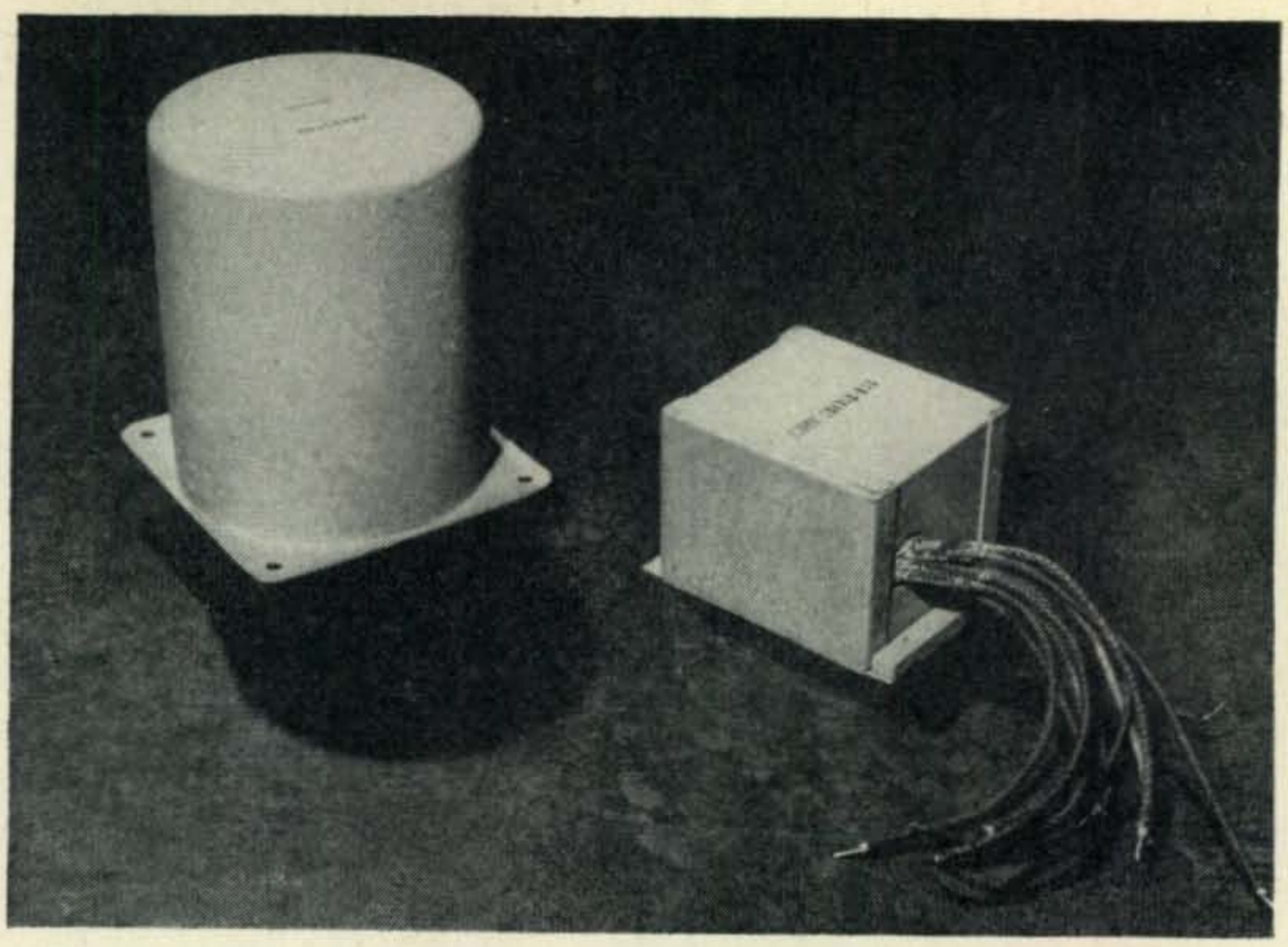


Fig. 2. Solid line-audio beat frequency, with change in receiver tuning. Dashed line—audio beat frequency, with change in receiver tuning, but suppressed in "single signal" reception

in them. In the high frequency bands, such selectivity was obtainable by the use of a quartz crystal filter inserted in the intermediate frequency amplifier. This filter can be made very sharp—to a point where there is a premium on stable transmitter and receiver oscillator so that signals will not drift off of the peak and require retuning of the receiver. Due to the selectivity of this device and increased phone operation, or for other reasons, the peaked audio amplifier rapidly fell into disuse.

Crystal Filters

During the war, the writer made numerous inquiries of Navy radiomen on their use of the crystal filters but found only one who claimed any familiarity with their operation. The operator on the *USS Kraken*, a submarine operating in the South China Sea, found that the crystal in a Model RBH(NC-100 modified for 1500 kc i-f) receiver made all the difference between turning out perfect copy from a fleet broadcast—through enemy and other interference—or missing a lot of it.



Navy type 30343 and 53090 reactors. Small and compact they are simple to install

Lack of familiarity with the proper operation of receiver crystal filters is too often noticed among amateurs. The claim has occasionally been heard that the filter in its selective position, on code reception, reduces the gain considerably. Of course, some loss in total amplification may be present and be justified, but is it a real loss? This situation has often been demonstrated with an old FBX whose lack of an r-f stage makes it a relatively insensitive, and therefore noisy receiver compared with recent designs incorporating an r-f stage that is "hot" even on the 28 Mc band. The visitor is asked to tune in a QRM'd c.w. signal and peak it on the crystal filter. The filter is then switched off, and the signal immediately becomes buried in interferences. After that, almost anyone will claim a gain for the crystal!

Those not familiar with these filters are more likely to judge them on the opposite kind of a test, as was made for the writer on an RCA DM-89—a triple-diversity rack built up from three AR-88 receivers. When a good signal was tuned in, the selectivity switch was turned far enough to bring the crystal filter into operation. At the most selective position, the signal was almost cut off, the drop being at least 20 db. Actually, someone had aligned the i-f amplifier of the receiver in the broadcast service manner and had neglected to do it exactly on the peak frequency of the crystal filter.

Normally, at frequencies at which some reasonable amount of r-f gain is obtainable, the signal-to-noise ratio in a receiver is established in the first r-f stage. This noise can be reduced in subsequent stages only by restricting the bandwidth of the receiver. That is what the crystal filter does. If the total gain of the receiver is slightly less with the crystal filter in the circuit, the loss can be overcome by raising the receiver gain. In any event, the signal-to-noise ratio

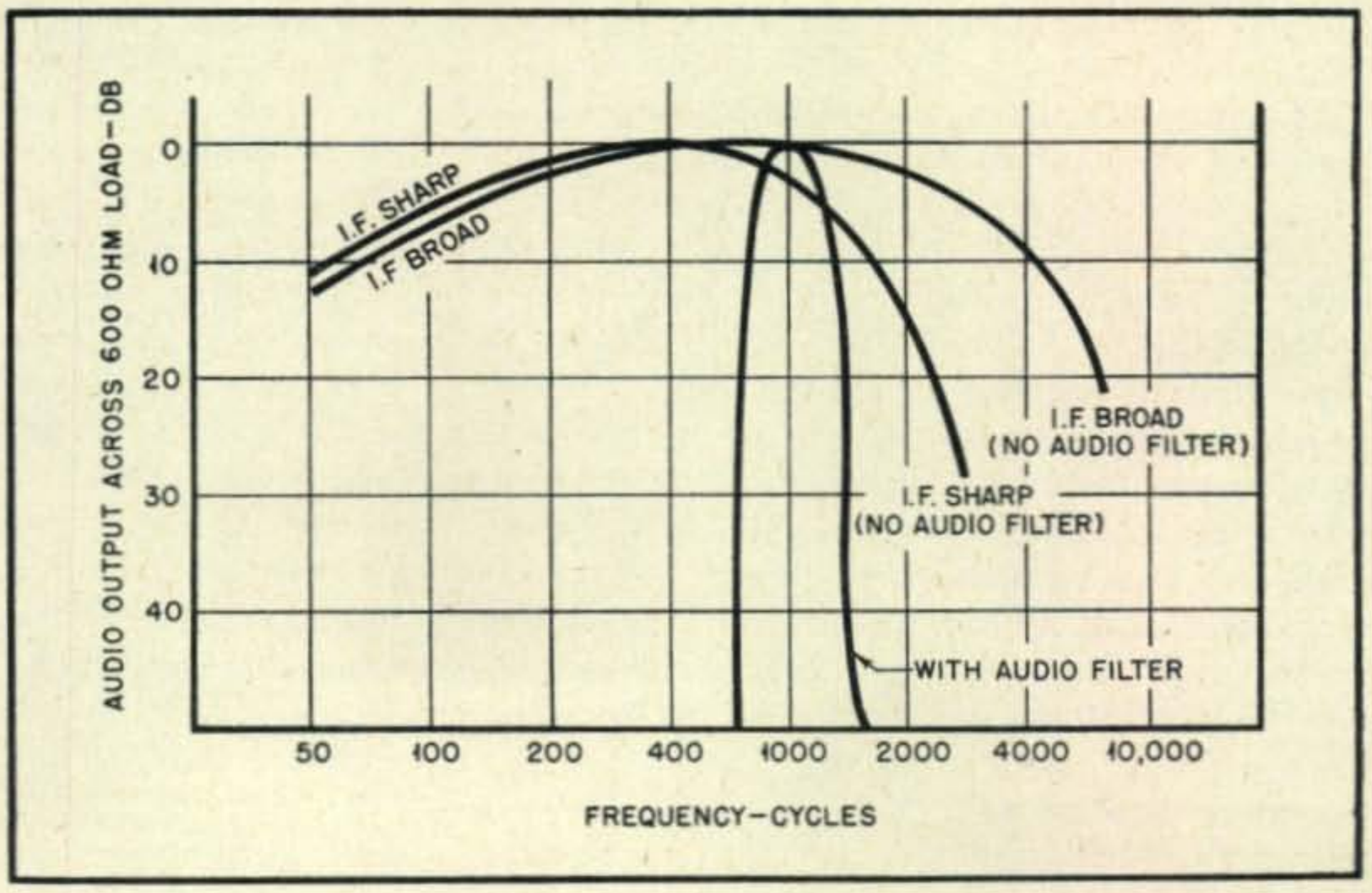


Fig. 3. Overall audio fidelity with two i-f bandwidths, and with type 53090 audio bandpass filter

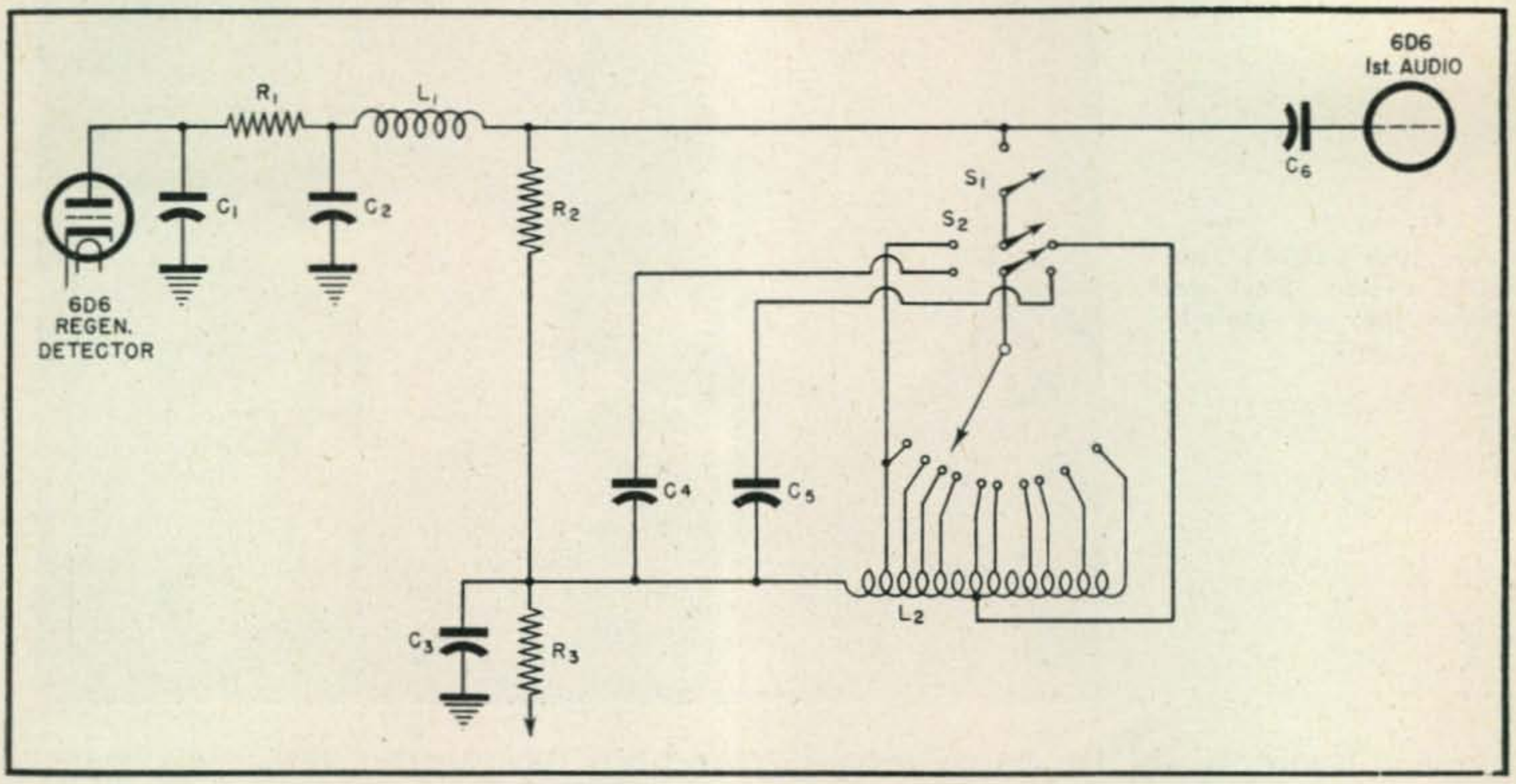


Fig. 4. Simplified detector-audio circuit of Navy model RAL high frequency regenerative receiver showing tuned audio circuit. This type filter is well adapted for amateur use

should be improved because of the decrease in bandwidth resulting from the greater selectivity. Inasmuch as sensitivity should be measured at some standard signal-to-noise ratio, this improvement results in an increase in sensitivity.

When this process is carried too far, noise pulses and the desired signal both start to have tails on them, giving the receiver a characteristic ringing noise that is disliked by most operators. The useful limit of selectivity with a crystal filter, therefore, has been reached when this ringing becomes evident. It can be attributed to the very high *Q* necessary to obtain an audio bandwidth of a few hundred cycles from a filter operating at the intermediate frequency of about 460 kc.

Band-Pass Filter

Standard Navy receivers have not used the old-fashioned peaked audio transformers, with their distortion on voice and the tuning difficulty which they create. Instead, they use a 1000-cycle band-pass filter in the audio circuit. This filter need not have very high *Q* to have a bandwidth of 200 or 300 cycles between points on the curve that are 6db down from the peak, so there is no disturbing ringing sound in the receiver. Furthermore, it is not difficult to construct the filter so that signals somewhat farther off frequency are attenuated greatly. It is only necessary to insert this kind of a filter in the circuit, with some arrangement that permits cutting it out for voice reception or while searching for a code signal. Care must be taken in tuning the receiver with the filter in, of course, because it is so easy to pass right over a signal.

The Navy's way still leaves the audio images that would have been rejected by a crystal filter. In order to get this advantage, and the ability to use the rejection notch of the crystal filter, the answer is simple—build amateur communication receivers with a relatively broad crystal filter, and arrange the selectivity switch so that in the *sharp* condition a filter is cut into the audio circuit. This will provide all of the advantages of both the crystal and the audio filter, without the disadvantage of either.

Fig. 1 shows the variation in audio beatnote in c.w. reception, with receiver tuning. This does not attempt to show the variation in strength of signal with its frequency which requires a three-dimensional representation of some kind. However, the dashed line shows the audio image that can be rejected by reasonably selective i-f systems, and by off-setting the beat oscillator. This produces what is widely known as *single signal* reception, reducing by one-half the number of signals that are heard when tuning.

Fig. 2 is a sample i-f selectivity curve for a crystal filter, in its various conditions of selectivity. *Fig. 3* shows the performance of the Navy type 53091 bandpass audio filter and the over-all audio selectivity curves with the i-f in *broad* and *sharp* conditions, and also with the audio filter in the circuit.

There are various sources from which the audio filters may be obtained. The Western Electric Company has at least one standard line of them—for use in carrier telegraphy over telephone and radio circuits. They are available with a band width of only 110 cycles for frequencies that are odd harmonics of 85 cycles, designed for use in

unbalanced circuits between 600-ohm impedances. Some of the type numbers for frequencies of possible interest in this application are listed below:

Frequency	*Type Numbers*
425	X63603C-L1-124A
	X63603J-L1-125A
595	X63603C-L1-124B
	X63603J-L1-125B
765	X63603C-L1-124C
	X63603J-L1-125C
935	X63603C-L2-124D
	X63603J-L2-125D
1105	X63603C-L2-124E
	X63603J-L2-125E

Many Navy receivers contain filters for one or more frequencies. Old or obsolete receivers such as Models RAA, RAB, RAK and RAL are possible sources, within the receivers or among spare parts, either of which may appear in lists of surplus material. The latter two models, in substantial quantity, appear on allowance lists for Naval Reserve members. Type numbers and other data on suitable Navy filters follow:

Navy Model RAB receivers contain type CRV-53010 band-pass filters. This has less than 6 db attenuation between 700 and 1300 cycles, and more than 40 db attenuation at 550 and 1600 cycles. It is normally inserted between two audio transformers having a 35.7/1 ratio, primary impedance 453 ohms, type CRV-30019.

Low-Pass Filter

Navy Model RAL high frequency regenerative receivers contain a low-pass filter which reduces tube hiss very materially, similar to the operation of a *tone control* but in general more effective with less disturbance to voice quality. They also contain a tuned reactance which may be used for c.w. reception. This reactance is type 30343. It contains 2500 turns of No. 29 enameled wire with nine taps following the 1360th turn, to provide audio tuning at various frequencies between 450 and 770 cycles with one condenser and between 770 and 1300 cycles with the other. The reactor and its paralleled condenser form a tuned circuit, being connected in parallel with the plate resistor of the detector, the voltage drop across the circuit feeding the next audio stage. The circuit appears in *Fig. 4*. The yellow-green lead from the reactor is the one that connects to the *low* end of the detector plate resistor, which is bypassed to ground. The red lead is the 1360th turn tap. The green lead is the end of the coil at 2500 turns.

The best filters in Navy receivers are types 53090 and 53091. These are complex band-pass filters, assembled in a can less than 4 inches in diameter and 4½ inches high. They are centered on 1000 cycles. They connect directly between two audio stages, as shown in *Fig. 5*. Type 53090

[*Continued on page 61*]

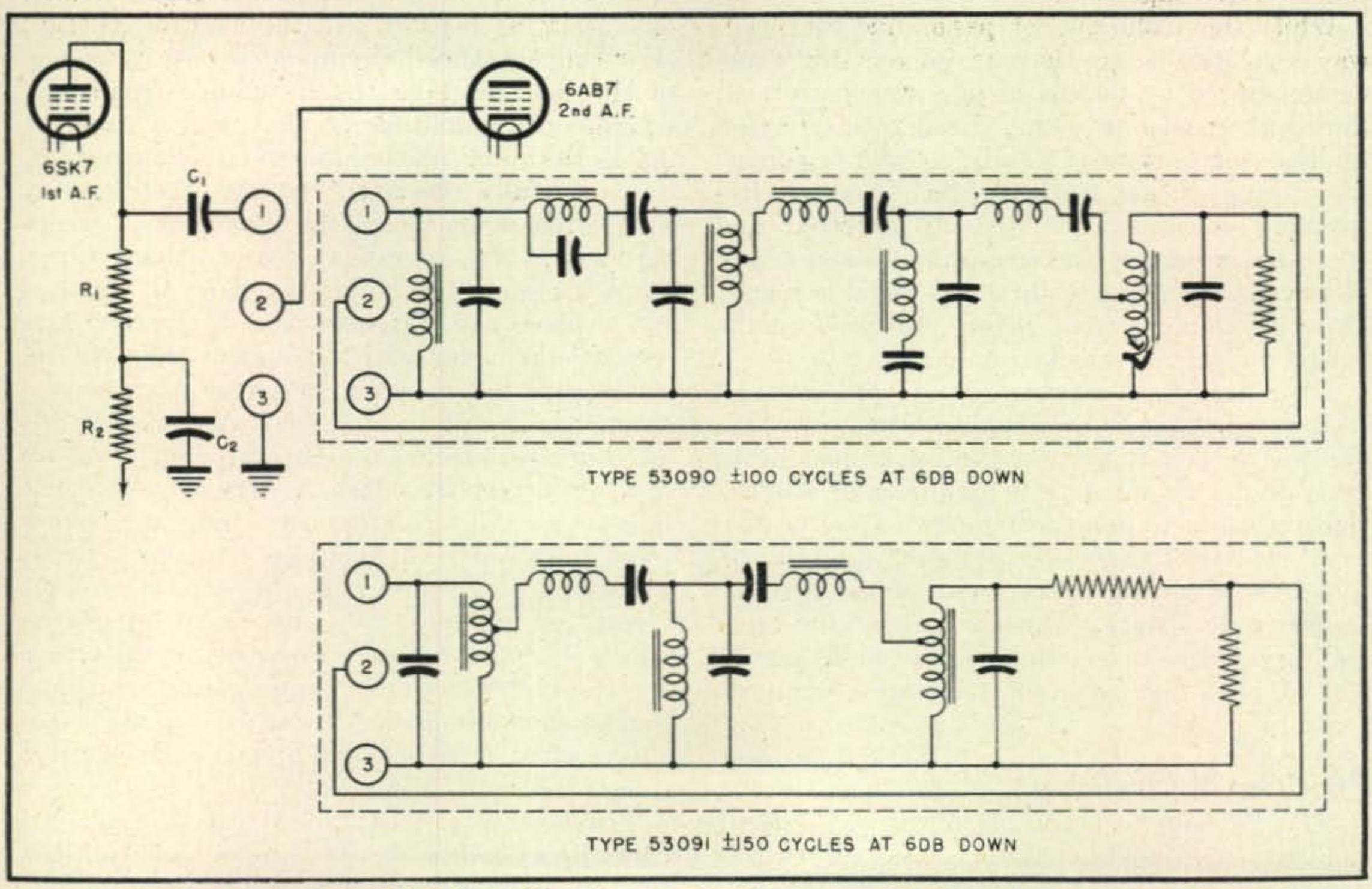
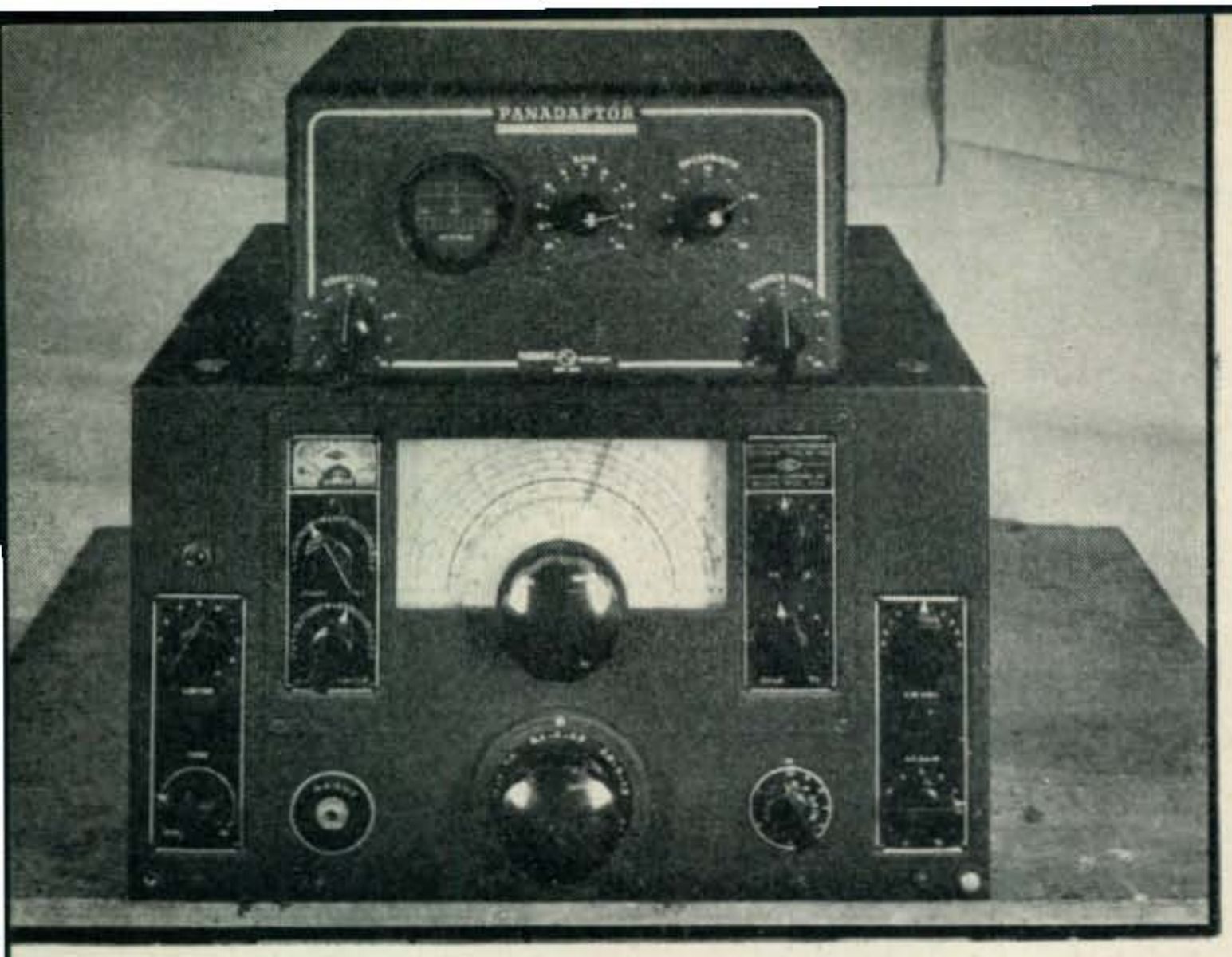


Fig. 5. Audio and bandpass filter diagrams for Navy type 53090 and 53091 audio filters



EYES

J. R. POPKIN-CLURMAN, W2LNP
AND J. S. BLONDER

THE BLINDERS have been removed from radio reception! A visual method of signal reception available to the amateur makes it possible to view radio signals of every type, at the same time, over a wide range of frequencies. The panoramic adaptor (September 1945 CQ) is complicated and like most ham receivers today is likely to be a commercial product. Nevertheless its impact on amateur operating procedures is likely to precipitate one of the first post-war steps in licking QRM. No ham contemplating extensive operation on the popular bands can afford not to consider panoramic reception as one possible solution to over-congestion.

While the technique of panoramic reception was developed before the war, its versatility was demonstrated by dozens of jobs well performed during the past four years. Used with direction finders for intercept and counter-espionage monitoring, illegal stations which changed frequencies constantly were easily detected and their disappearance and reappearance constantly observed. Signals not aurally detectable due to noise interference were visibly indicated on the screen and not overlooked in tuning.

Distress and other emergency signals, often off designated channels, would have been almost impossible to detect without the use of panoramic reception. To foil enemy jamming of low-frequency point-to-point communications, a constant watch of the screen for such activity enabled the receiving operator to advise direction and extent to shift frequency. These and other military applications point the way to invaluable aid in ham operation for panoramic equipped stations.

Principles of Operation

The *Panadaptor* is an instrument designed to convert any superheterodyne receiver into a panoramic receiver. An average superheterodyne receiver has a bandwidth response of 10 kc, or less, determined by the response of the i-f tuned circuits. The r-f tuned circuits are quite broadly tuned in comparison, and include signals removed 100 kc or greater on either side of the frequency to which the receiver is tuned. The receiver local oscillator beats against the r-f frequencies and at the plate of the converter tube produces a wide band of signals centered about the receiver i-f frequency. The i-f of the receiver then amplifies only the desired center frequencies and these are reproduced in the speaker.

Utilizing the wide band of frequencies available at the plate of the converter tube, the *Panadaptor* input is connected to this point through a 50,000 ohm isolating resistor. In the adaptor, special, close-coupled, tuned circuits at the i-f frequency of the receiver take the incoming signals and equalize the amplitude so that over a range of 200 kc the amplitude becomes relatively constant.

A carefully designed electronic frequency modulated oscillator in the *Panadaptor* sweeps through a 200 kc range of frequencies thirty times a second, the center frequency of which is 226 kc above the i-f frequency of its receiver. This oscillator is mixed with the signals from the receiver and the resulting difference signals pass through a sharply tuned 226 kc i-f stage in the adaptor, are detected, and displayed on a cathode ray tube screen. In effect, we have an electronic finger—the FM oscillator—sweeping an r-f spectrum 200 kc wide. Every time that finger points to a signal, there appears on the cathode ray tube screen, an inverted "V" for the frequency to which the finger points. A baseline on the screen represents frequency, the center point of the baseline being the frequency to which the receiver is tuned; all other frequencies up to 100 kc on either side of the center being displayed as well.

The horizontal location of a peak along the calibrated baseline of the scope screen indicates the frequency of its respective signal. Amplitude or height of the peak shows signal intensity. The

FOR YOUR RECEIVER

More on Panoramic Reception, a visual method of signal reception. What it can do for the amateur, how to connect the *Panadaptor*, to your receiver, and other useful information is discussed in detail. In panoramic reception the ham may have the key to the QRM problem

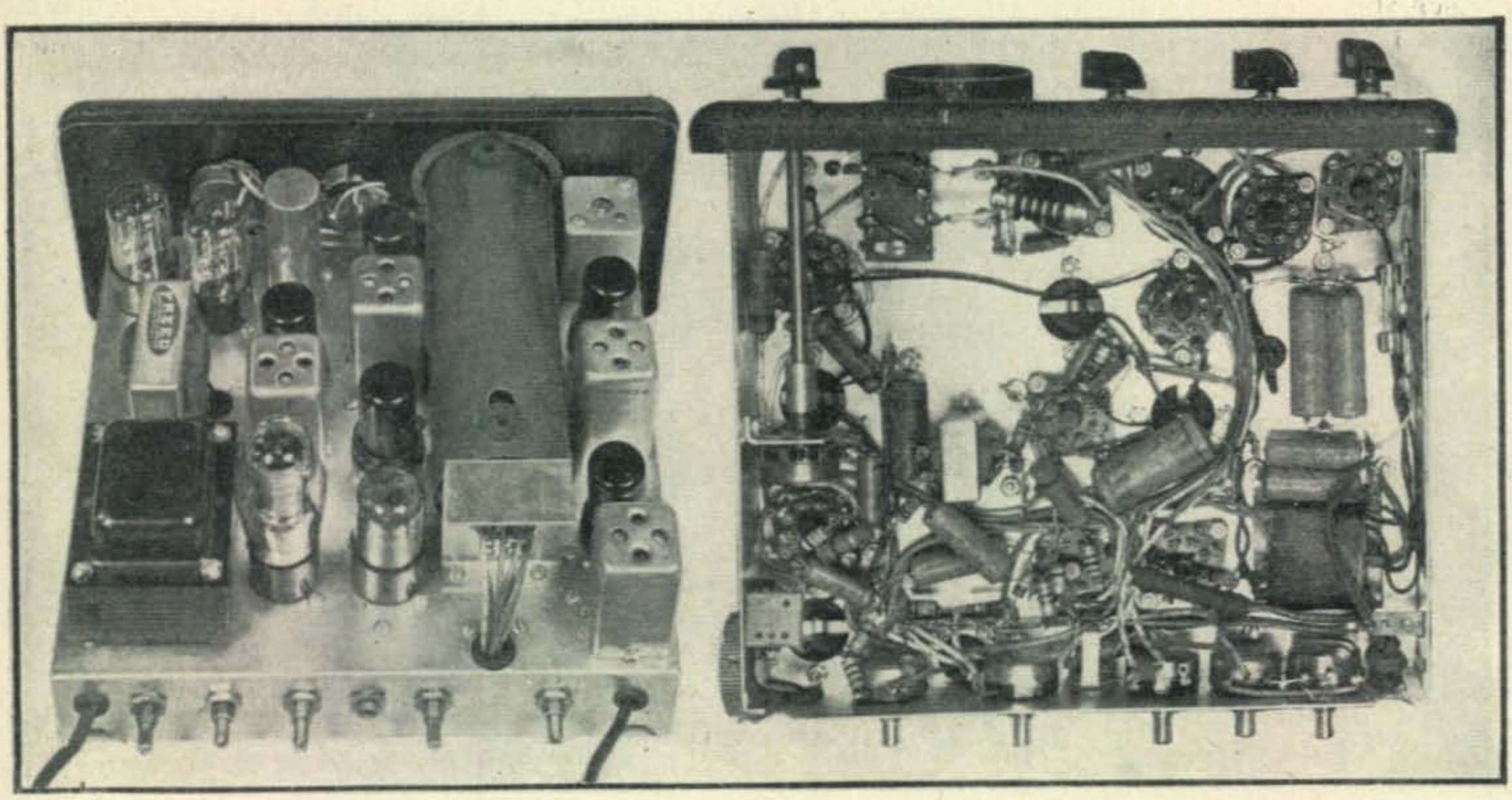
visual sweep-width is continuously selectable from a broad band of frequencies down to zero. Reducing the sweepwidth reduces the number of signals which can be seen, while magnifying those which are visible. In addition, various frequencies shown, may be compared with reference to each other, or with reference to the receiver's tuning dial. For instance, if the receiver dial reads 5000 kc, the signal appearing immediately above zero on the scale has that frequency; a signal read from the screen at −100 kc has a frequency of 4900 kc, etc. As the receiver is tuned to a different frequency, the peaks will move correspondingly to the right or left across the screen.

Regardless of the frequency to which the receiver may be tuned, the *Panadaptor* will show not only the received signal, but every signal 100 kc on either side of the received signal, provided visual sweepwidth is set at maximum. The manifold possibilities of panoramic reception should now become apparent. The amateur can use his eyes as well as his ears, resulting in an infinite increase in the operating efficiency and performance of his own station! By making a wide range of radio signals visible, a new dimension is added to the field of radio operating.

Panoramic Reception

Other stations are left far behind when it comes to moving into a clear local channel if unaided by panoramic reception. By merely selecting the spot on the screen and tuning the transmitter into it, QRM to yourself and others is avoided.

No need to wear out the receiver dial mechanism and the operator trying to locate a CQ. The screen tells the whole story and many a CQ buried in noise and interference can be found which would never have been detected without



Panadaptor. Note controls brought through the rear of the chassis, used for occasional adjustments.

panoramic reception. This is an actual fact since a signal below the receiver noise level will still push up the scope baseline giving a definite indication of its presence. Once a weak signal is seen, all the tricks in the bag can be used to read it.

Besides its usefulness for normal operation, a new kind of net can be set up. Assign everyone a frequency and use the panoramic screen to do the monitoring. To identify a station, it is necessary only to check the frequency to which the station was assigned. Relative position of the signals on the screen affords precise information on the presence of the stations in the net. Frequency corrections can be made from the control station without delay. For round tables, some of which can get really involved, panoramic reception is a natural.

For FM, information on modulation index, distortion, center frequency, and frequency drift is readily obtained. In contemplating narrow band FM, a visual check on the signal, once tried, becomes indispensable.

The usefulness of any receiver is multiplied by taking advantage of the aural feature. Assume the receiver tuned to one station and a new signal bobs up on the screen that warrants investigation. Plug in a pair of high impedance earphones, (crystal preferred) or an auxiliary amplifier, to the phone jack on the *Panadaptor*. Bring the desired signal to the center of the screen by means of the center frequency control and then turn the sweepwidth to zero. The station will be audible in the earphones. In like manner the entire band of 100 kc around the frequency of the station to which the receiver is tuned can be examined. If desired, the *Panadaptor* can be tuned to one station and the receiver to another, allowing both to be heard with the same receiving set-up.

Converter Tube Chart

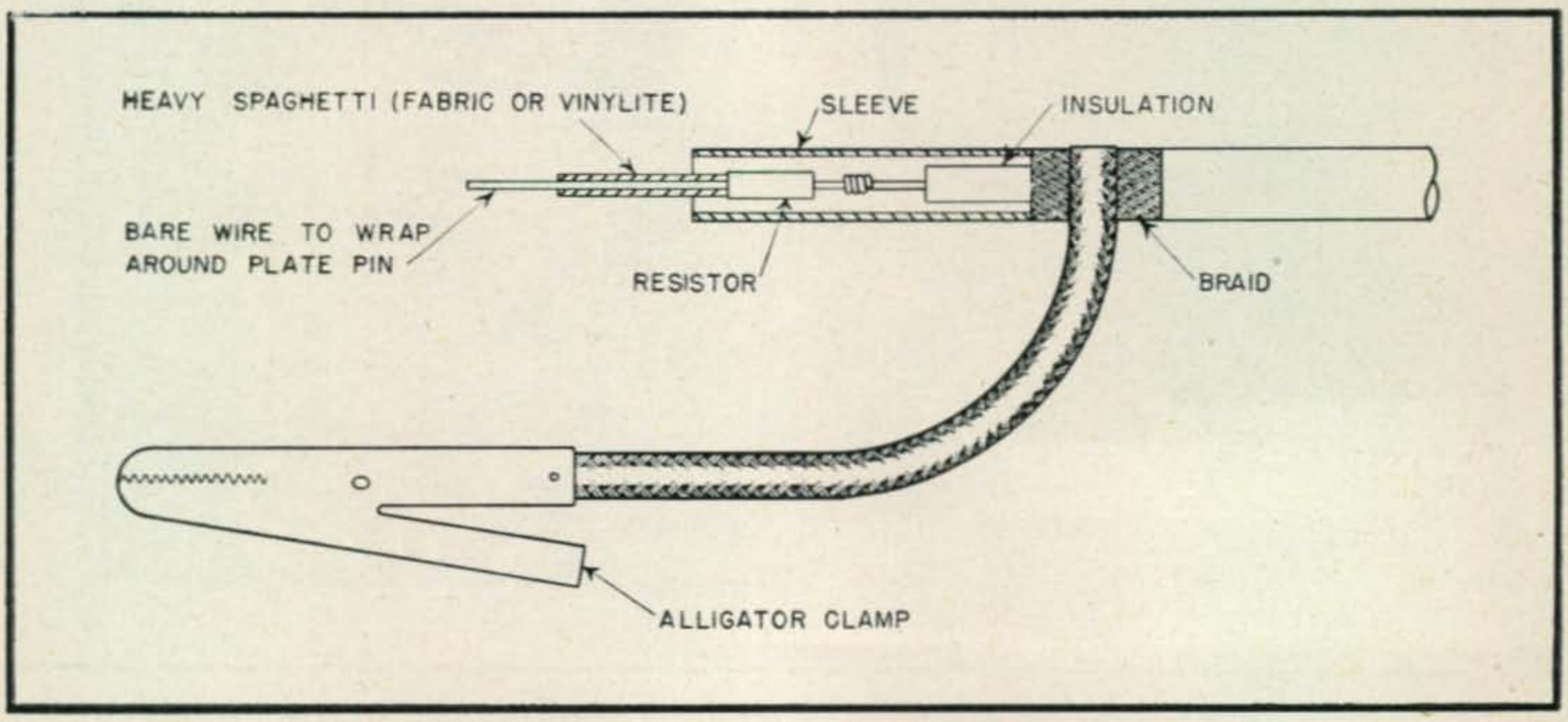
Type	Plate pin no.*
1A7	3
6A7	2
6A8	3
6J8	3
6K8	3
6L7	3
6SA7	3
6SB7	3
7Q7	2
12SA7	3

*(Looking at the bottom of the socket or at the base of the tube).

Visual observation of signals with the *Panadaptor* makes it possible for the amateur to analyze the type of transmission whether it be CW, phone, FM, facsimile, etc. For a more detailed description of the appearance of the signals, refer to the article in the September 1945 issue of *CQ*.

Other practical applications of panoramic reception include:

1. Spot frequency modulation or parasitics on an amplitude modulated signal.
2. Measure percentage of modulation and the quality of the signal being transmitted under all conditions.
3. Read signal strengths instantaneously. This instantaneous field strength indicator will aid in quickly adjusting the output stages of the transmitter or the field strength of directional antennas.
4. Check other frequencies against known standards or the receiver calibrations. Any frequency drift can be spotted immediately and the amount of drift calculated.



Mechanical method of connecting panoramic adapter to receiver

A running check of transmitter frequency can be given as it changes.

5. Show where and how much to shift frequency to avoid interference once a QSO is under way and the kind of interference which is blanketing the desired signal.

Connecting the Adaptor

The *Panadaptor* can be easily connected to any receiver with an i-f between 450 kc to 470 kc. Many amateur communications receivers are being manufactured with a panoramic connector, in which case it is necessary only to connect the adaptor cable between "PAN" on the receiver and the input connector on the adaptor. If no connector is provided, there are two methods that can be used for making the installation.

One end of a 50,000 ohm ½ watt resistor is clipped short and soldered to the end of the RG/58U coaxial cable leading to the input of the *Panadaptor*. A piece of spaghetti is slipped over the other pigtail of the resistor and it is cut to leave about 3/8" of bare wire and 1" to 2" of covered pigtail wire. A short piece of wire with a clip attached to one end, is soldered to the shield of the coaxial cable. The assembly is then brought in through the receiver avoiding any sources of heat, and the bare end of the resistor pigtail wrapped around the plate pin of the converter tube. The tube is reinserted into the socket, *care being taken to see that the spaghetti insulates the resistor from contact with ground.* The clip is attached to the nearest ground point and the installation is complete.

Parts required for the permanent soldered connection are an isolating resistor of 50,000 ohms ½ watt, a standard male and female coaxial connector and mounting accessories.

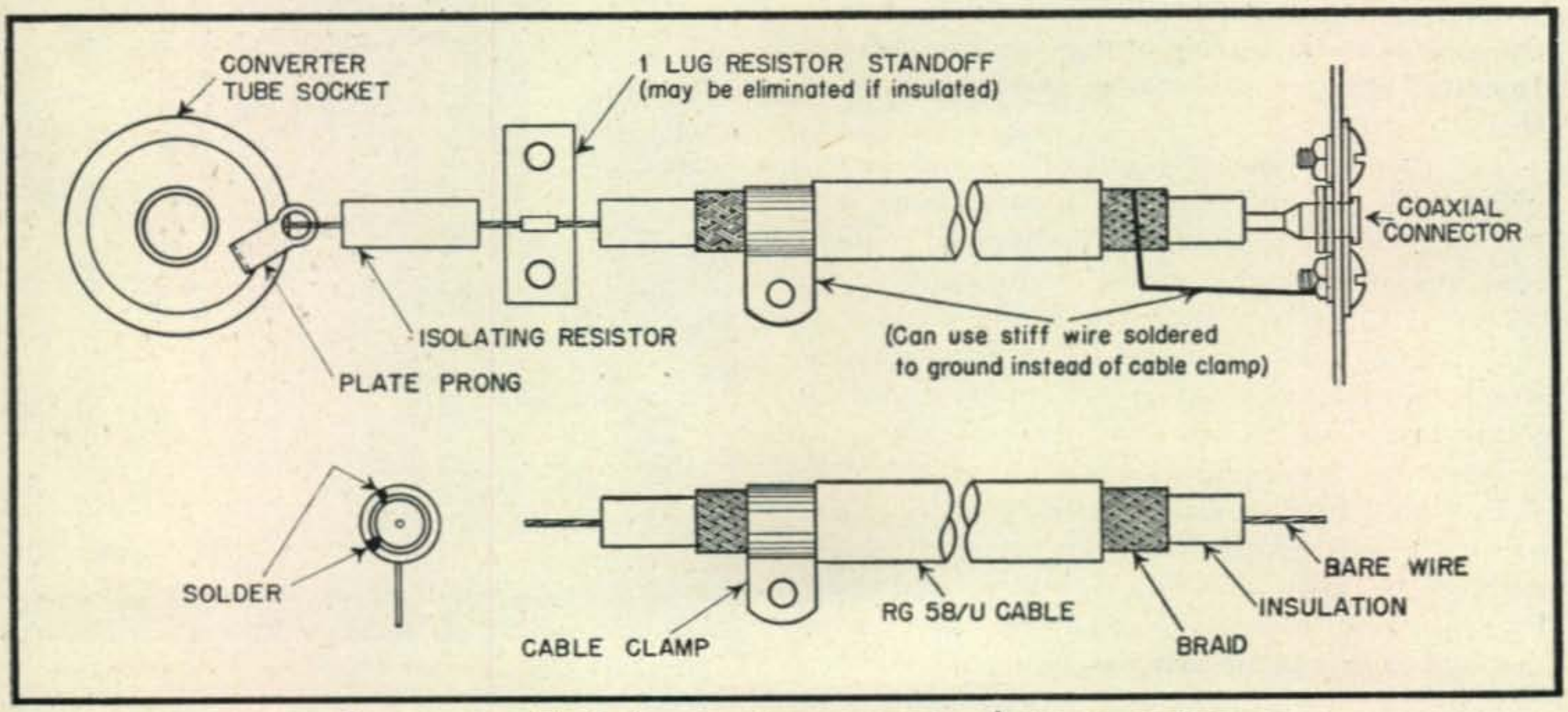
As near to the converter tube as possible, determine the most suitable and convenient location on the receiver chassis to mount the female connector. If space permits, mount a one-lug standoff near the plate prong of the converter (1st detector) tube socket so that the 50,000 ohm resistor can be supported between the plate prong and the standoff lug. The resistor should be mounted as close to the plate prong as possible to minimize the possibility of detuning.

A length of the RG/58U coaxial cable supplied with the *Panadaptor* will reach from the plate pin to the female connector. It is necessary that the overall length of input cable remain about the same as supplied because it is part of the tuning capacity of the first coil. Tin the exposed shield at one end of the cable and solder the cable clamp or supporting wire to it, as shown. Ground the cable clamp or wire to the chassis, near the resistor standoff. Solder the inner conductor of the cable to the resistor standoff lug, thus connecting together the isolating resistor and the cable.

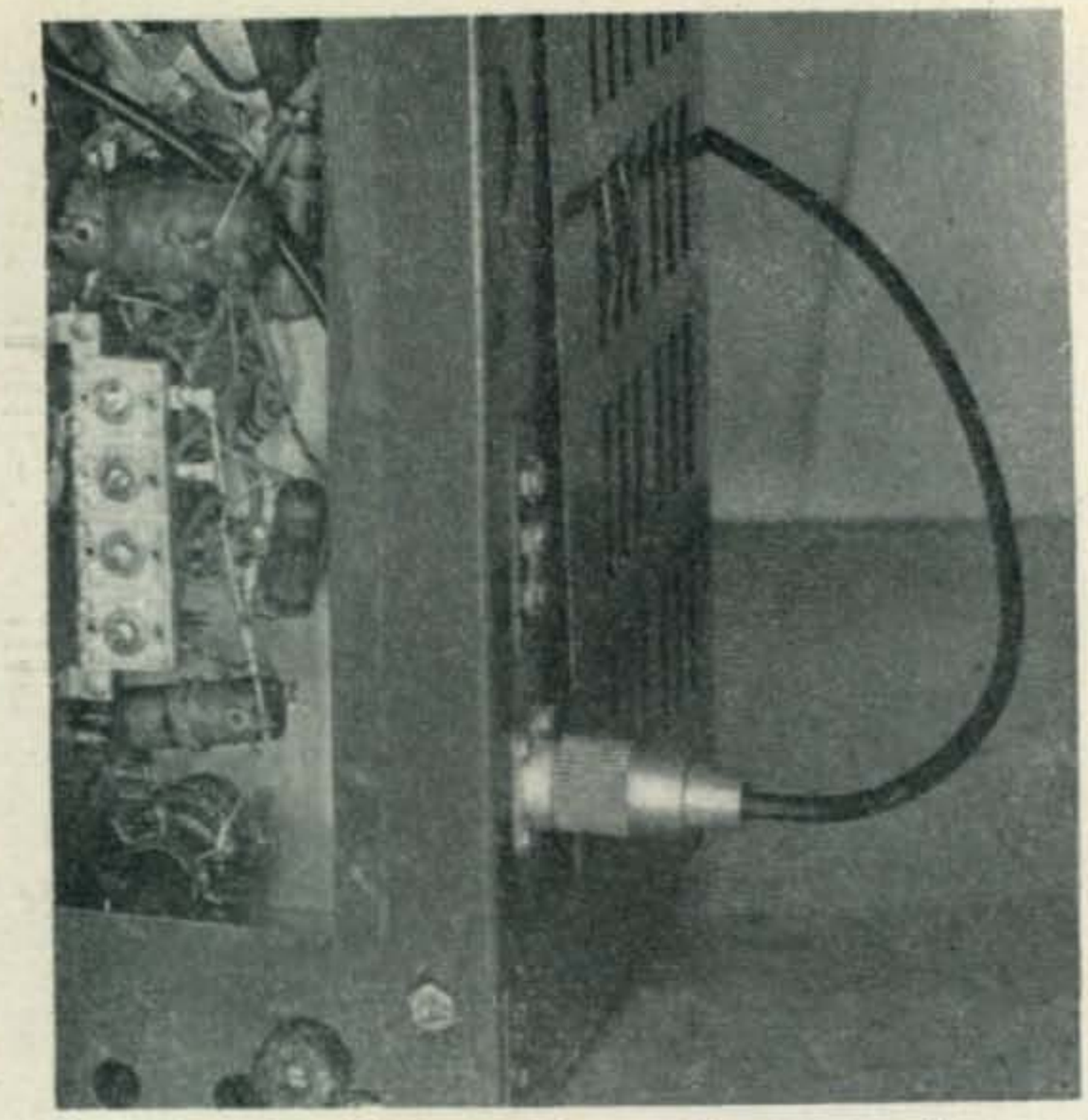
If, however, it is impossible to mount the standoff, then fasten the cable clamp to the chassis so that the isolating resistor is supported by the plate prong and the inner conductor of the cable. A short circuit between the "hot" lead of the cable and ground may be avoided by slipping a piece of spaghetti over the resistor-cable joint. Connect the other end of the inner conductor to the female connector pin, grounding the shield. Solder the male connector on the coaxial cable attached to the *Panadaptor*.

The Panadaptor Controls

There are four controls that are commonly used in operation of a *Panadaptor:* equalizer, gain, center frequency, and sweepwidth. Five controls



Permanent method of connecting panoramic adaptor to receiver



Permanent installation with co-ax connector shown in bottom view of Hallicrafters S-20R

are screwdriver-adjusted when the unit is placed in operation and seldom require adjustment thereafter: intensity, focus, horizontal position, vertical position, and sweep pad. The gain control of the *Panadaptor* is independent of the receiver.

The equalizer control adjusts the response characteristic of the *Panadaptor* to approach the desired flat bandpass over a 200 kc band. The necessity for this control arises from the fact that not only do individual receivers vary in their r-f response, but in the same receiver the r-f selectivity changes with the band selected. The method of adjustment is to select a steady signal, tune the receiver over the band represented on the screen and compensate for any change in visual signal strength across the screen by finding the most suitable setting of the equalizer control. In actual practice, it is seldom necessary to make this adjustment.

The center frequency control is employed to bring the signal on the screen in coincidence with the received aural signal. This merely requires that any recognizable signal be brought to the center of the screen with the receiver tuned to that signal, and subsequently every signal to which the receiver is tuned will appear under the center line of the screen.

The sweep control gives a continuous variation of the band swept by the *Panadaptor* from zero up to the full width of 200 kc. The control is marked to give the approximate bandwidth. Precise measurement of frequencies away from the centerline can be made with markers from a crystal-controlled multivibrator external to the panoramic receiver.

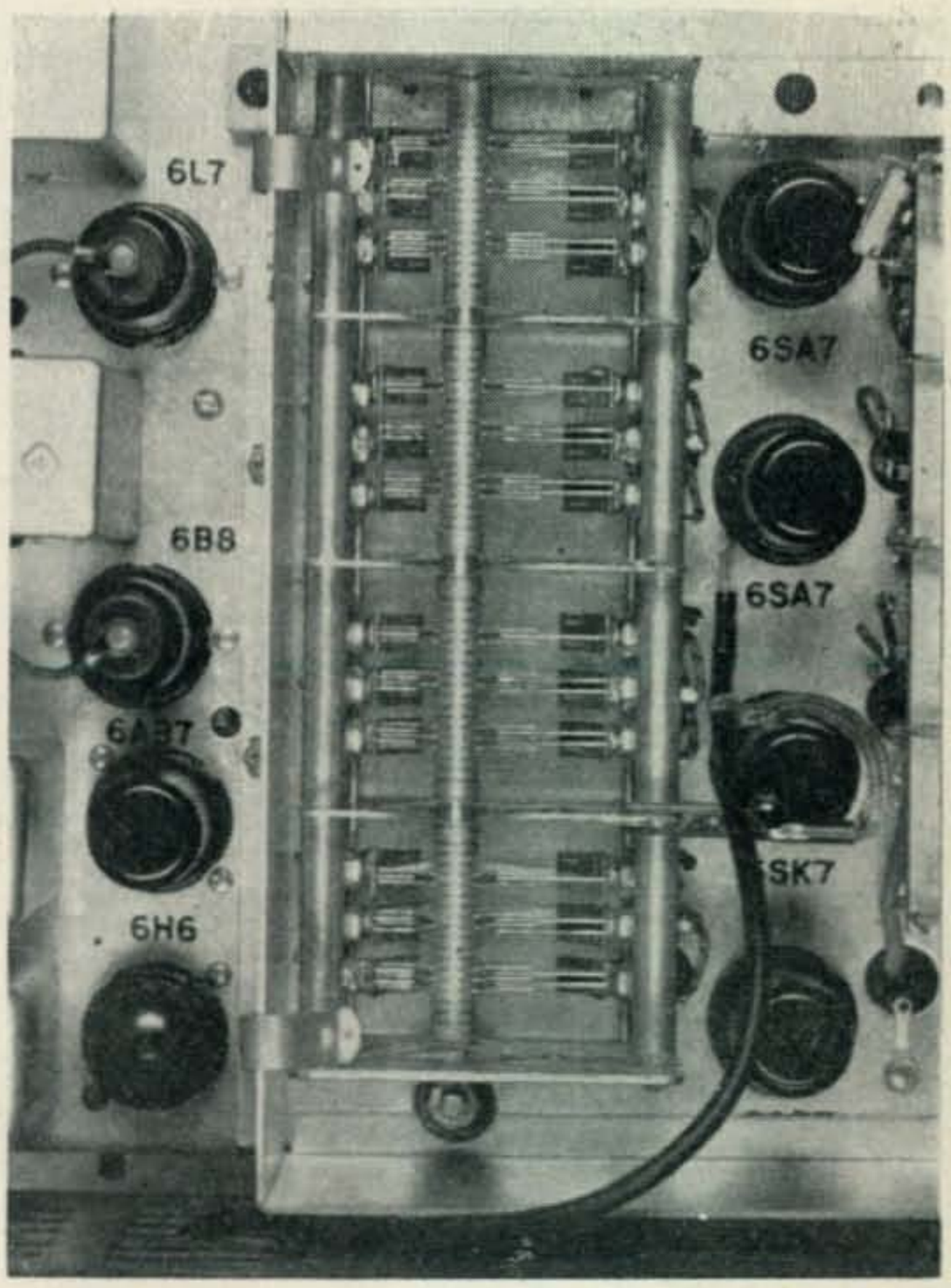
The intensity, focus, horizontal position, and vertical position screwdriver controls are self-explanatory.

The sweep-limit screwdriver control sets the limit of 200 kc on the bandwidth and seldom requires adjustment.

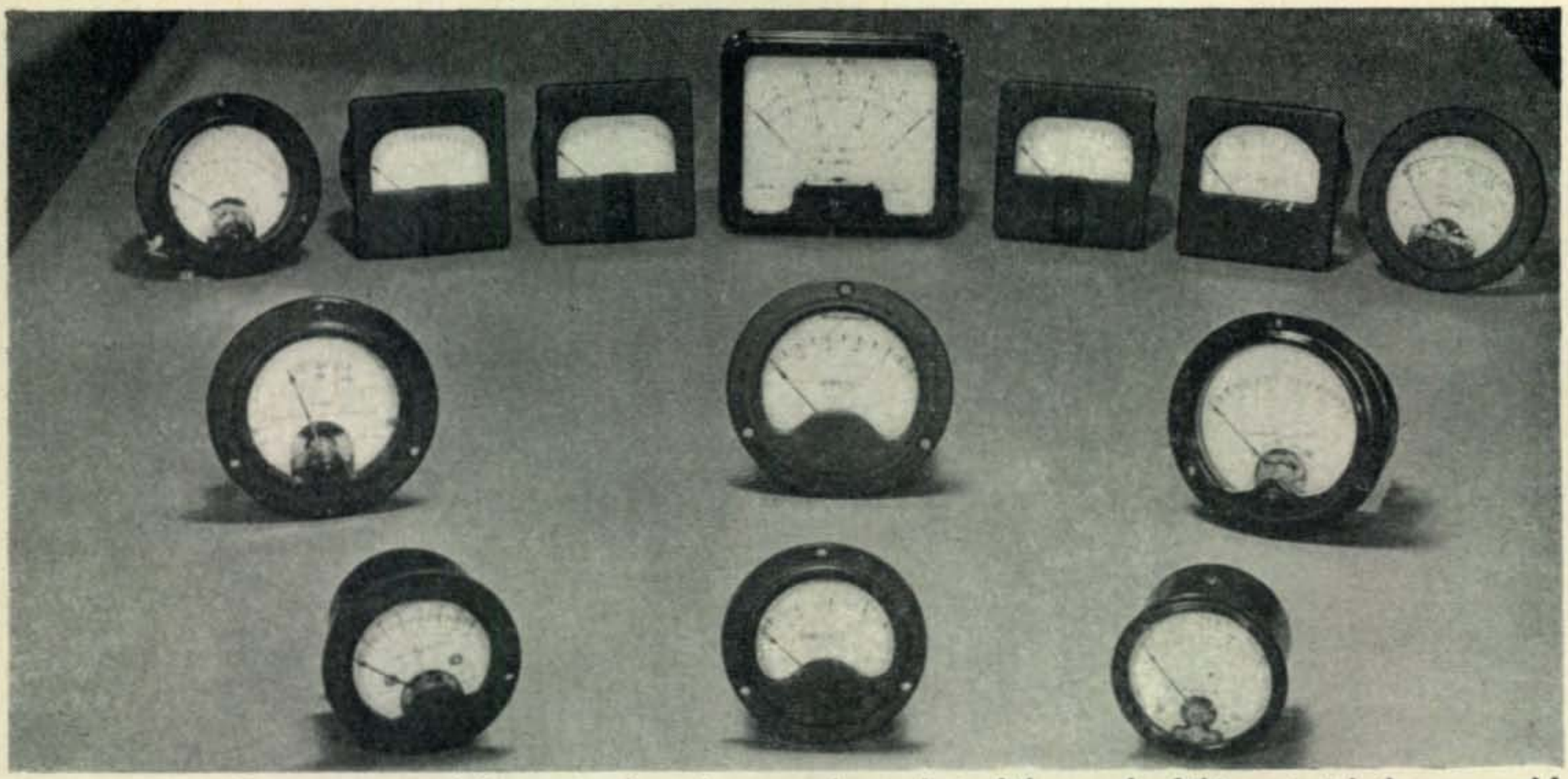
Once the preliminary adjustments have been made, the *Panadaptor* is as simple to operate as the tuning dial of a receiver and, in fact, for most uses requires no adjustment aside from the gain control. The signal coming through the receiver speaker appears directly over the zero calibration of the screen. If it is desired to examine the nature of the signal more closely, varying the sweep control will expand the signal to any desired extent. Good operating practice dictates keeping the gain of the *Panadaptor* at a minimum to reduce the effects of interference, tube noise, cross modulation, etc.

AVC will reduce the sensitivity of the *Panadaptor* to weak signals when a strong signal is tuned in by the receiver, so that it may be desirable to operate without AVC in some cases.

Simple and effective, panoramic reception may prove to be one of the most valuable war perfected instruments yet made available to the ham. Its technique and application in amateur radio will bear careful study particularly in view of potential increases in ham ranks.



Mechanical installation showing connection brought through vent slots and tied to tube base pin



Surplus meters of every type and description have been on the market. Like much of this material, they are sold out rapidly. Matching cases, especially with particular values, is a tedious shopping job even in surplus centers

More On Surplus

MAURICE GUTMAN, W2VL

So many requests were received for additional information that W2VL got together his latest notes to give you this report

SEVERAL MONTHS have passed since the last report on surplus radio material for the ham.

Many *CQ* readers have requested additional and up-to-date information, a difficult assignment because conditions are constantly changing. The Small War Plant Corp. has been eliminated and its duties absorbed by the RFC. Electronic material is still disposed of in the same fashion, that is, through designated agents of the RFC such as Hallicrafters' RFC department, Electronic Corporation of America, Remler, Raytheon, Emerson, and others.

RFC Surplus

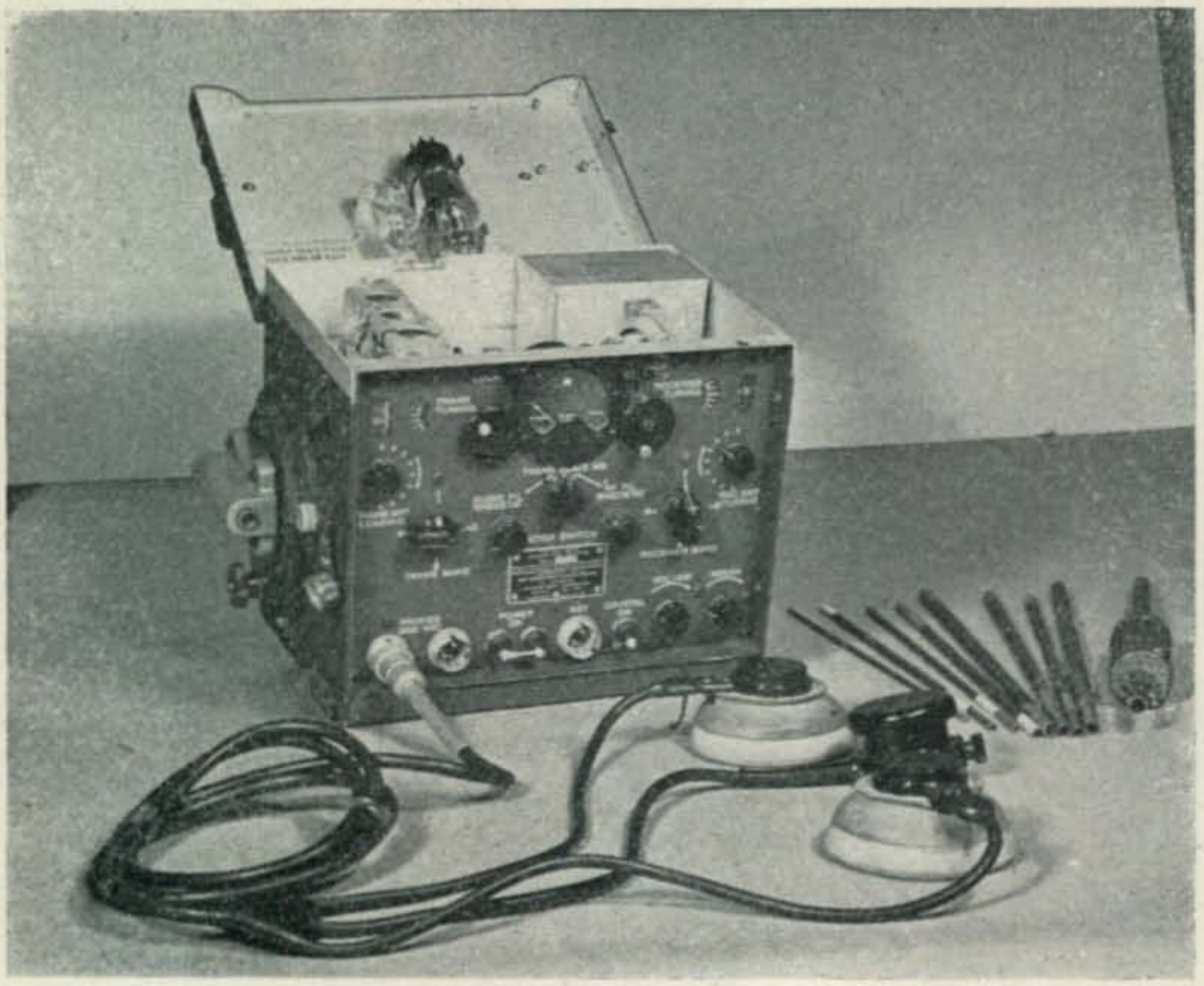
To be eligible to buy directly from the RFC outlets a ham has to be a radio parts distributor, dealer, manufacturer, or a veteran of the armed forces. When qualified to purchase surplus from the RFC agents, a permit must still be obtained from the RFC itself. Their offices may be found in most large cities, or the RFC may be contacted in Washington, D. C.

Even when permitted to buy from surplus depots considerable time in shopping around for specific needs must be spent, as choice items go quickly, with quantity usually limited. Of course, much surplus can be obtained from retail outlets, which is where most individual amateurs have obtained this material to date. It should be emphasized that there are good reasons for not always purchasing surplus . . . even in instances where identical merchandise can be gotten at a substantial saving.

Retail Surplus

When purchasing at a retail store, good clean tested equipment and specialized advice is available. Surplus goods, when handled retail are the best of the material, already carefully picked over. There are several organizations who specialize exclusively in war surplus radio parts. They have men constantly canvassing RFC outlets for equipment. These concerns provide the out-of-town buyer with services comparable to that of a purchasing agent, the local dealer acting as the customers representative in handling the merchandise. Desirable equipment for the ham may be secured faster and at a very reasonable price in this manner.

Someone might well ask the questions: "When

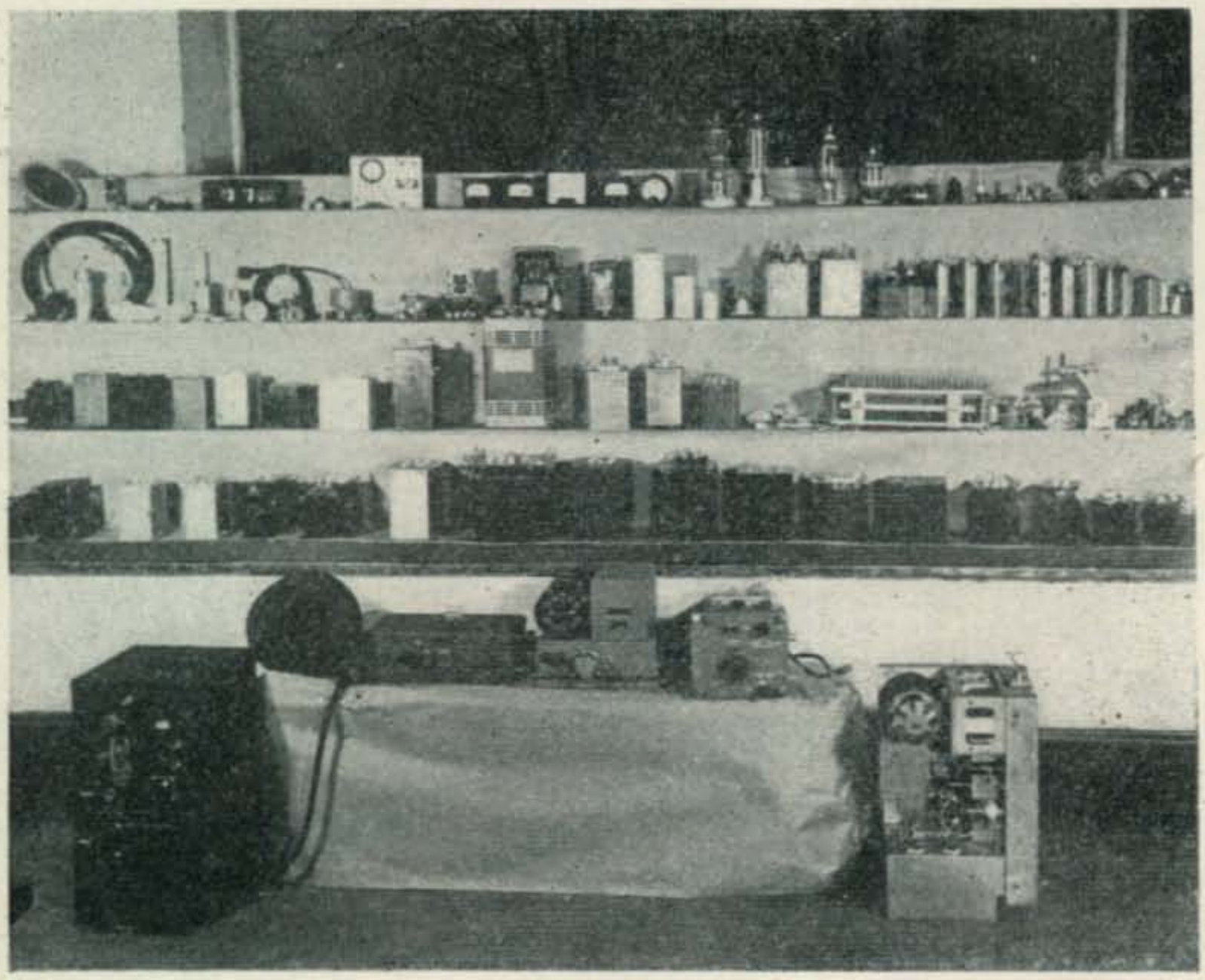


Surplus Navy transceptor from 28 to 80 mc. Uses turrets for bandswitching of transmitter and receiver. Receiver is a super-regenerative type. Transmitter is a modulated oscillator

is it better *not* to buy surplus?" The answer is obvious once you've looked over such equipment. None of it carries any kind of guarantee whatsoever. Once bought, you have absolutely no recourse if it proves unsatisfactory. Much of the equipment is of a highly specialized nature, which might be tempting because it is a good "buy," eventually to accumulate as junk in your shop. Improperly marked or unmarked equipment might just as well be for 12 or 24 volt, for 400 cycles, or a variety of odd frequencies used in military apparatus.

Material Available

The variety of surplus carried by the average surplus dealer is well illustrated in the photographs taken in one such shop. They are all items for sale to the ham. Recently one of these stores placed on sale an Army type TRC 10 transmitter and receiver, complete with an AC power supply for less than forty dollars. Self-contained in a cabinet small enough to place in a desk drawer, the unit contains a five tube superhet receiver with preselection, BFO, complete coverage from



Surplus! Everything from A to Z, although not always what you want when you want it

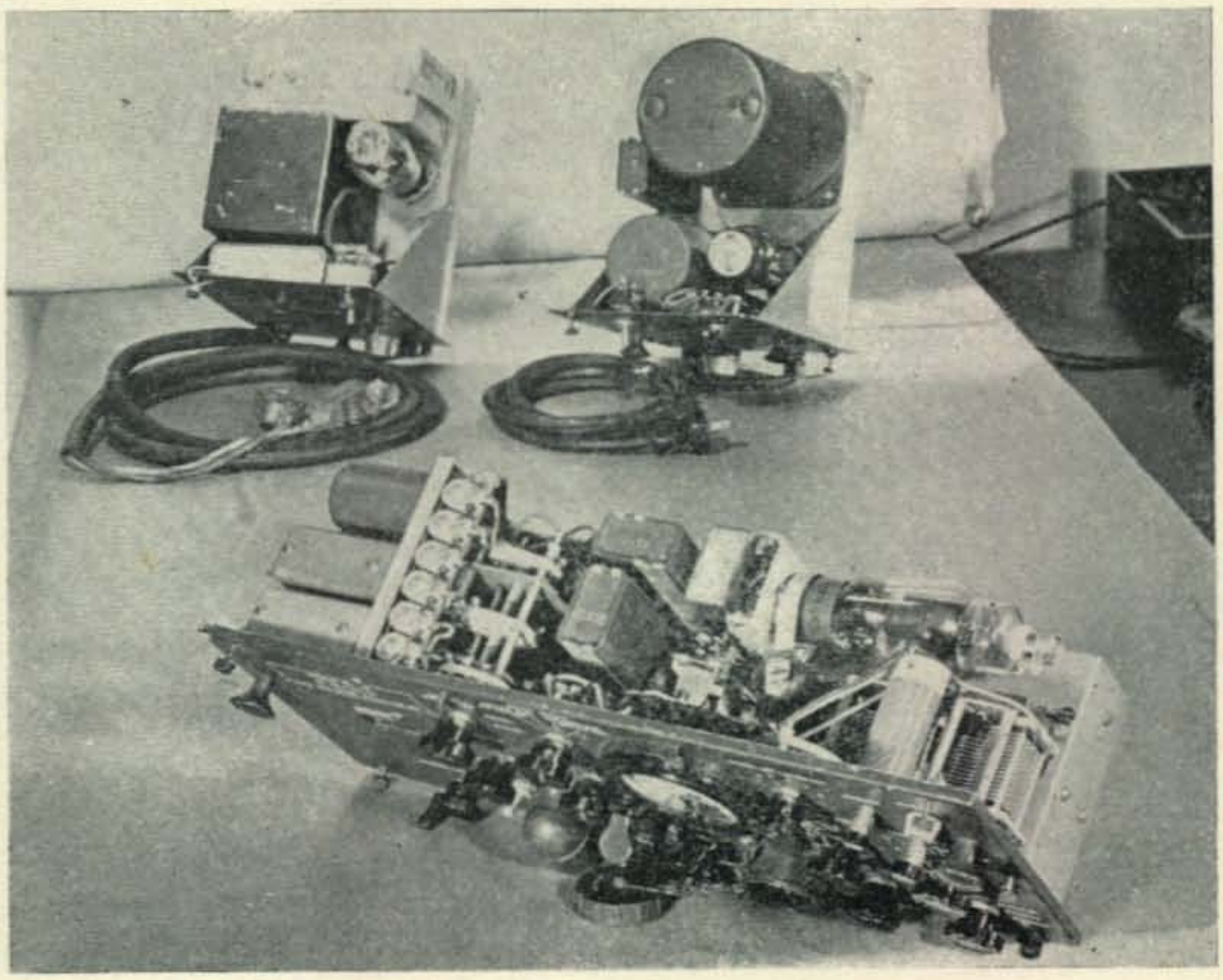
Complete transmitter and receiver with both 6 volt d-c supply and 110 volt a-c supply. The superhet receiver and crystal control transmitter will cover 80, 40, and 20 with only slight modifications. Items like this appear on the market every now and then

2 through 12 Mc plus a crystal controlled transmitter with an output of 25 to 30 watts. For field day or portable work of any type, a vibropack type supply with matching cables was available at the time for approximately another fourteen dollars.

There were only some 40 units placed on sale and naturally they sold very rapidly. Nevertheless this is a typical example of what appears on the market from time to time. It is, unfortunately, quite true that amateurs living in the large metropolitan areas have a decided advantage over out-of-town hams. The only apparent solution to this geographic inequality is to write retail stores in the large areas asking them to keep you posted on their individual purchases, or better yet outline to them your needs.

December *CQ* discussed an ECO in somewhat the same category as other particularly desirable surplus. Numerous readers have written to ask where they may get one. Those placed on sale went rapidly. Since that time no more of that particular item has appeared. There have been a

[*Continued on page 60*]



Good mechanical construction and high quality parts is typical of most surplus equipment. But modification may often be a bigger headache than starting from scratch. Spares may often be unobtainable. All these factors must be carefully evaluated

A Low Cost

450 WATT CW RIG

FRANK C. JONES, W6AJF

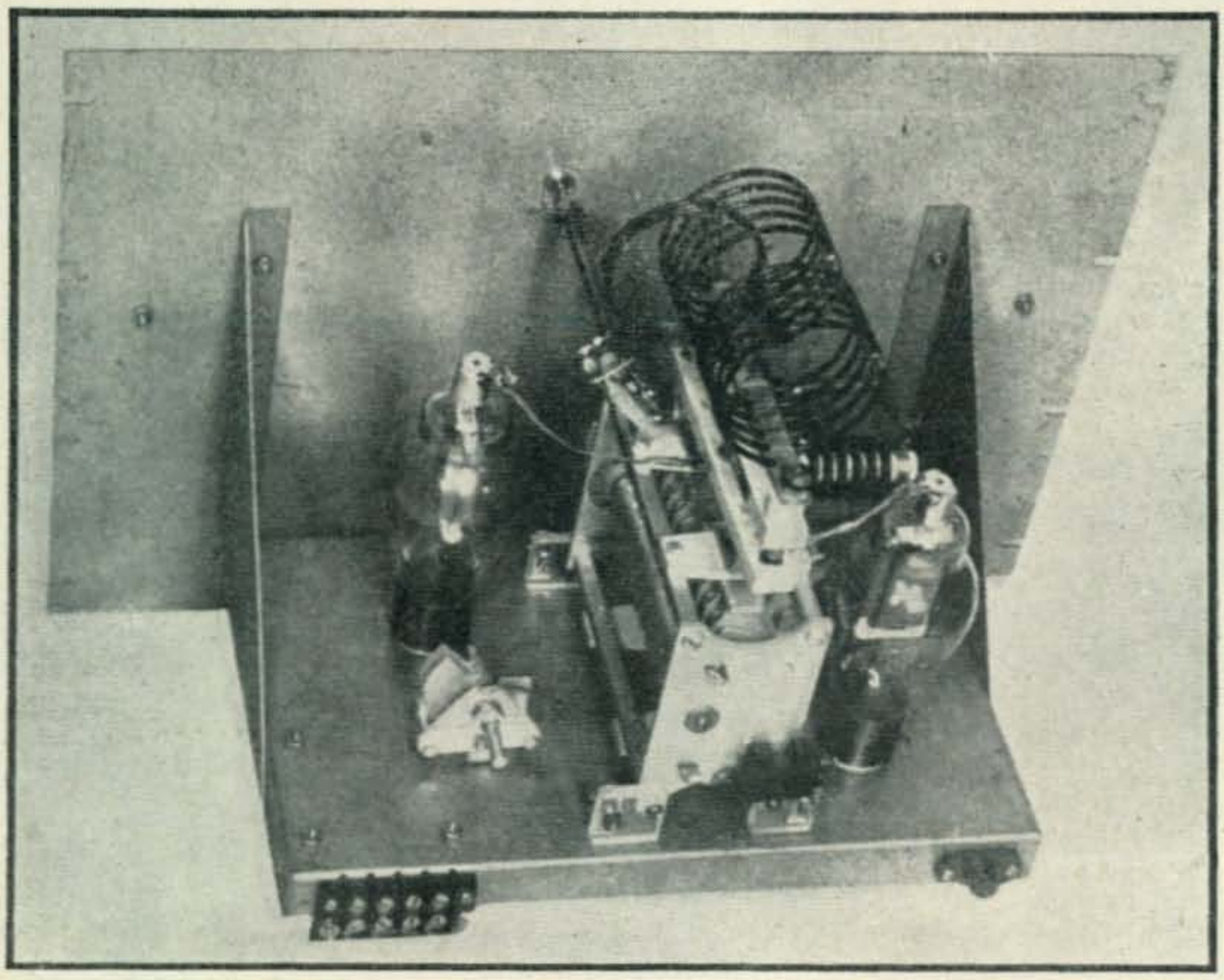
Frank Jones can always be expected to come up with some unusual ideas. Incorporated in this low cost 450 watt rig are some particularly good power supply features that are applicable to practically every transmitter being constructed

THE VFO EXCITER described in the December 1945 issue of *CQ* was designed as the driver of a c.w. transmitter using a pair of 811 tubes in the final amplifier. These tubes are low priced, easily driven, and will handle up to 450 watts input in a c.w. amplifier. Their high *mu* characteristic permits keying in a preceding circuit without fixed bias for key-up conditions. With a reasonably well regulated 1500 volt power supply, key-up no load current is from 25 to 30 ma. Cathode current (2 tubes) for maximum load conditions with key-down is 375 ma.

Design Considerations

Often a push-pull triode amplifier of this type is subject to VHF parasitic oscillations. Parasitics are easily discovered by observing the final amplifier grid current when no r-f excitation is present (key-up condition). The meter reading should remain constant when swinging the tank capacitor through a complete cycle. To prevent objectionable parasitics it is desirable to wire in parasitic suppressors at the points marked "x" in the 811 tube circuit. These suppressors may be of 5 to 8 turns of #14 wire ½" diam. shunted by a 200 or 300 ohm resistor, connected in series with the grid leads near the tube sockets.

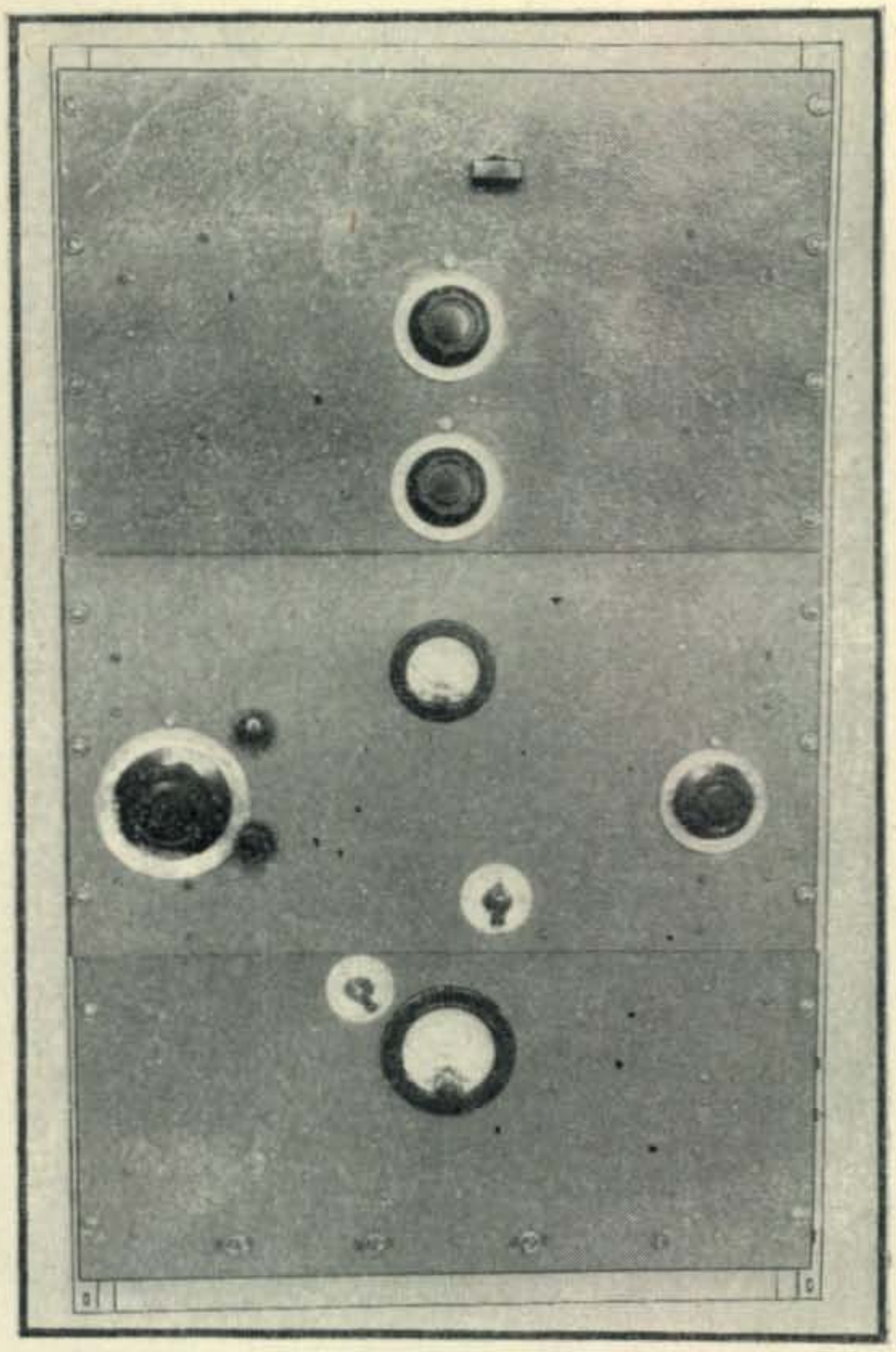
A standard form of push-pull amplifier construction with short r-f leads and the grid and plate circuits separated by the chassis as a shield is used. When constructed, variable link coupled units were not obtainable, though plug-in coils of one type or another were available. The variable link coil is extremely useful for coupling



Looking down on Jones 450 watt PA. Design is conventional, straightforward and clean. The grid circuit is mounted below the chassis for maximum shielding

into a load. Normally no antenna coupler is needed and antenna feeders of 400 to 600 ohm impedance can be connected directly to the 3 turn link coil. The r-f amplifier is loaded up to normal plate current or 275 to 300 ma. (325 to 375 ma. cathode current) by increasing the coupling to the plate tank coil while keeping the latter at resonance.

The variable coupling unit illustrated in the photographs was built by using a few small parts and a 3 turn 2½ inch diameter coupling coil. The coil is mounted on a 1" square piece of polystyrene near the coil leads. The insulating block is mounted on a piece of ¼" diameter brass rod (flattened near its end) by two machine screws. Fairly heavy flexible leads from the coil to the antenna feed-through insulators in the top of the proposed transmitter cabinet (not yet available) permit varying the position of the coupling link. Final amplifier coils have approximately an inch gap in the center of the winding, into which the coupling coil can be swung. The panel bearing consists of a stiff spring telephone jack which holds the shaft in any position of rotation. A knob on the front panel against the jack, and a set-screw collar around the shaft at the rear of the panel jack, prevents longitudinal displacement with possibility of the coupling coil touching the high voltage final tank coil.



Front view of the completed transmitter showing placement of all controls

Exciter Unit

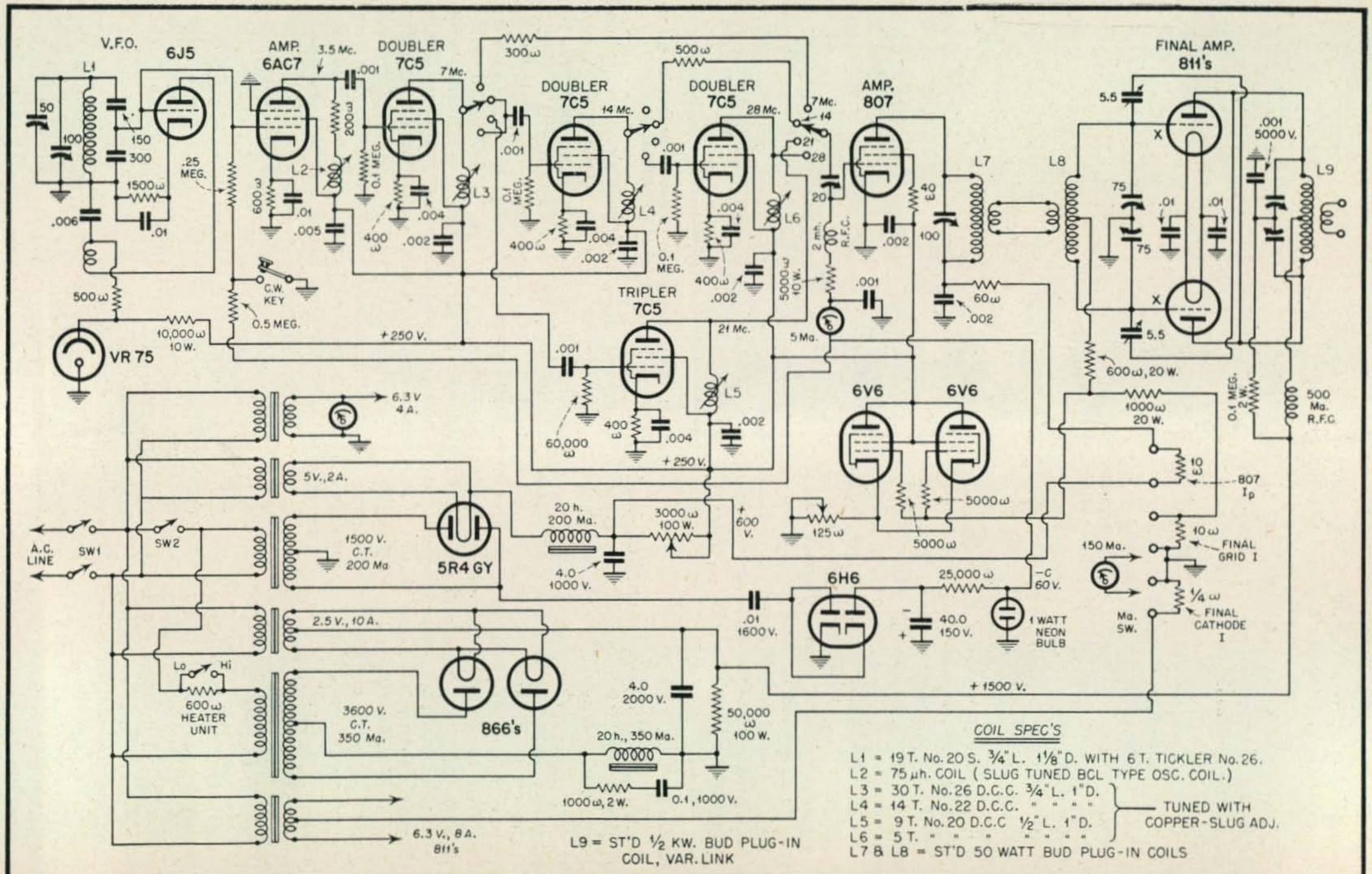
Reference to the December issue of *CQ* is advisable for a full description of the exciter. Briefly, it consists of a stable VFO with a 6J5 triode and a 6AC7 buffer class A amplifier operating in the 3.5 mc. band. The doubler and tripler stages with 7C5 tubes provide broad band output to drive the 807 exciter amplifier grid in any band from 7 to 28 mc. The plate circuits are peaked at the middle of each band and resistors in the individual circuits broaden out the tuning to give nearly constant grid current to the 807 over the entire tuning range. The VFO and 807 plate circuit are the only tuned circuits which must be adjusted when shifting frequency. The final amplifier grid and plate circuits are also tuned to resonance.

Power Supply Circuits

Perhaps the most interesting portion of this transmitter is in the power supply circuits. Some of the circuit ideas, shown in the circuit diagram, can be applied to nearly any radio transmitter where forms of voltage regulation are needed. The simple method of improving the high voltage supply regulation is desirable in any cw transmitter. The filter choke is tuned broadly to 120 cycles, the main ripple frequency, by means of a condenser and resistor across the choke. The resistor is necessary to prevent excessive "Q" and high ac voltage. The size of condenser depends on the filter choke inductance value with the key-up (low DC values of current). A small 1000 volt .1 μf condenser will tune the choke to 120 CPS if its inductance is about 18 henrys. The condenser size can be determined experimentally by varying it in moderate steps while checking the output voltage for key-up and key-down load conditions. Proper tuning will reduce the voltage change when keying from 400 or 500 volts to less than half of this value. The tuned choke gives the effect of a very large inductance at the ripple frequency, improving regulation.

VR Bias Supply

C bias supply for 807 tubes or for blocked-grid keying is always a problem. It can be solved by the use of a *shunt type* voltage doubler rectifier, a 6H6, and a one watt neon bulb. The low voltage transformer has one side of its secondary connected to the rectifier through a small .01 μf 1600 or 2000 v. paper condenser to drop the ac voltage to a reasonably low value. Only a milliampere or two of DC is needed to keep the neon bulb ionized and the 807 grid current can then vary from zero to 3 or 4 ma. without an appreciable change of C bias voltage. A small RC filter

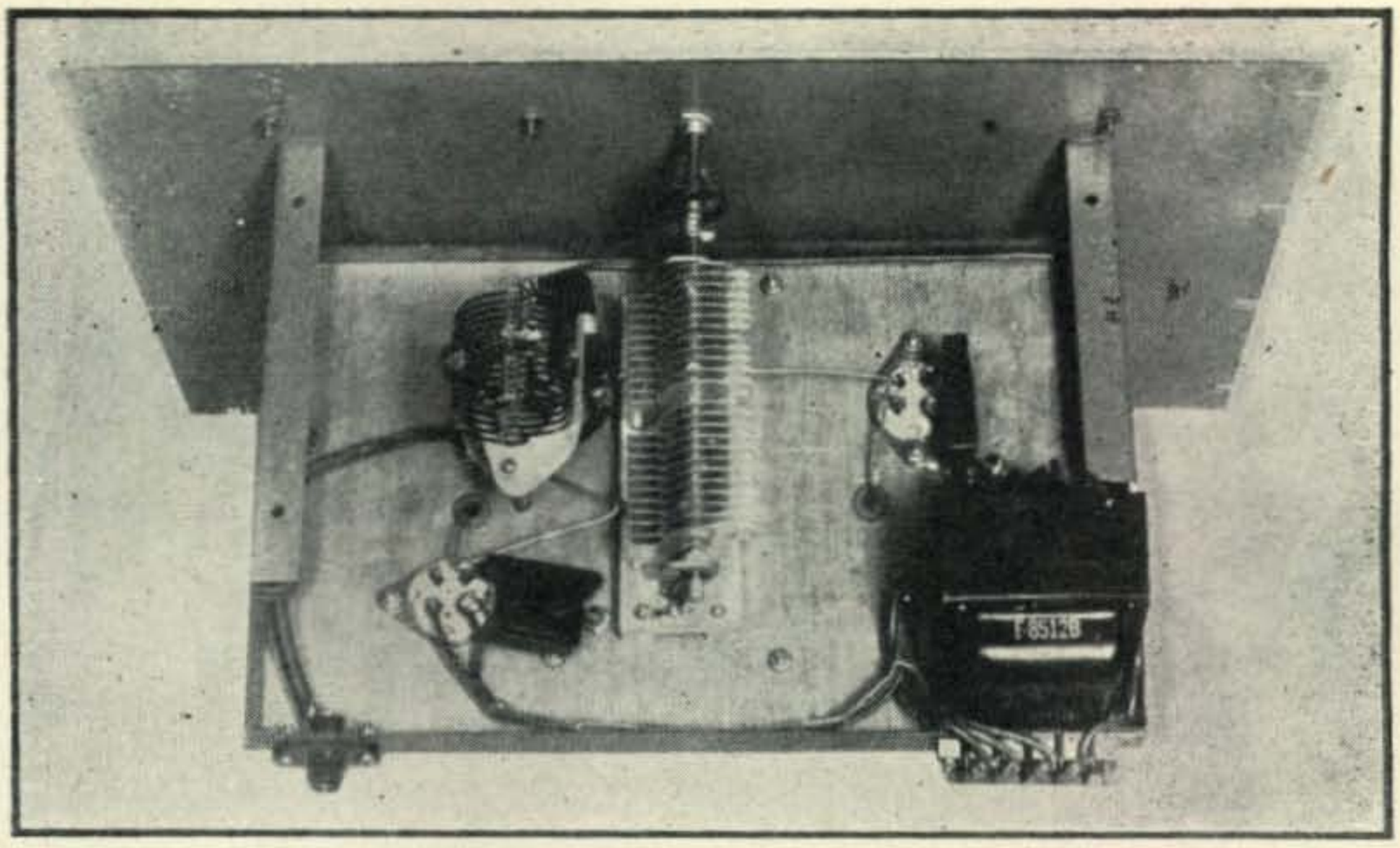


COIL SPEC'S

L1 = 19 T. No. 20 S. ¾" L. 1⅛" D. WITH 6 T. TICKLER No. 26.
L2 = 75 μh. COIL (SLUG TUNED BCL TYPE OSC. COIL.)
L3 = 30 T. No. 26 D.C.C. ¾" L. 1" D.
L4 = 14 T. No. 22 D.C.C. " " " "
L5 = 9 T. No. 20 D.C.C ½" L. 1" D.
L6 = 5 T. " " " " " " "
} TUNED WITH COPPER-SLUG ADJ.
L7 & L8 = ST'D 50 WATT BUD PLUG-IN COILS

L9 = ST'D ½ KW. BUD PLUG-IN COIL, VAR. LINK

Schematic of Jones 450 watt c.w. transmitter. Unusual power supply design makes this rig of particular interest to anyone rebuilding



Grid circuit of the PA is well isolated by the chassis shield. Filament transformer mounted on the same deck as the tubes gives better voltage regulation

in the rectifier output will smooth out the half wave pulses of current into DC to keep the neon bulb regulator functioning. The use of a larger series dropping capacity to the transformer, a 6H6, an LC filter and a VR 75 or 105 with 5 ma. of "keep-alive" current will handle C bias supplies where the grid current is not over 30 ma. when transmitting.

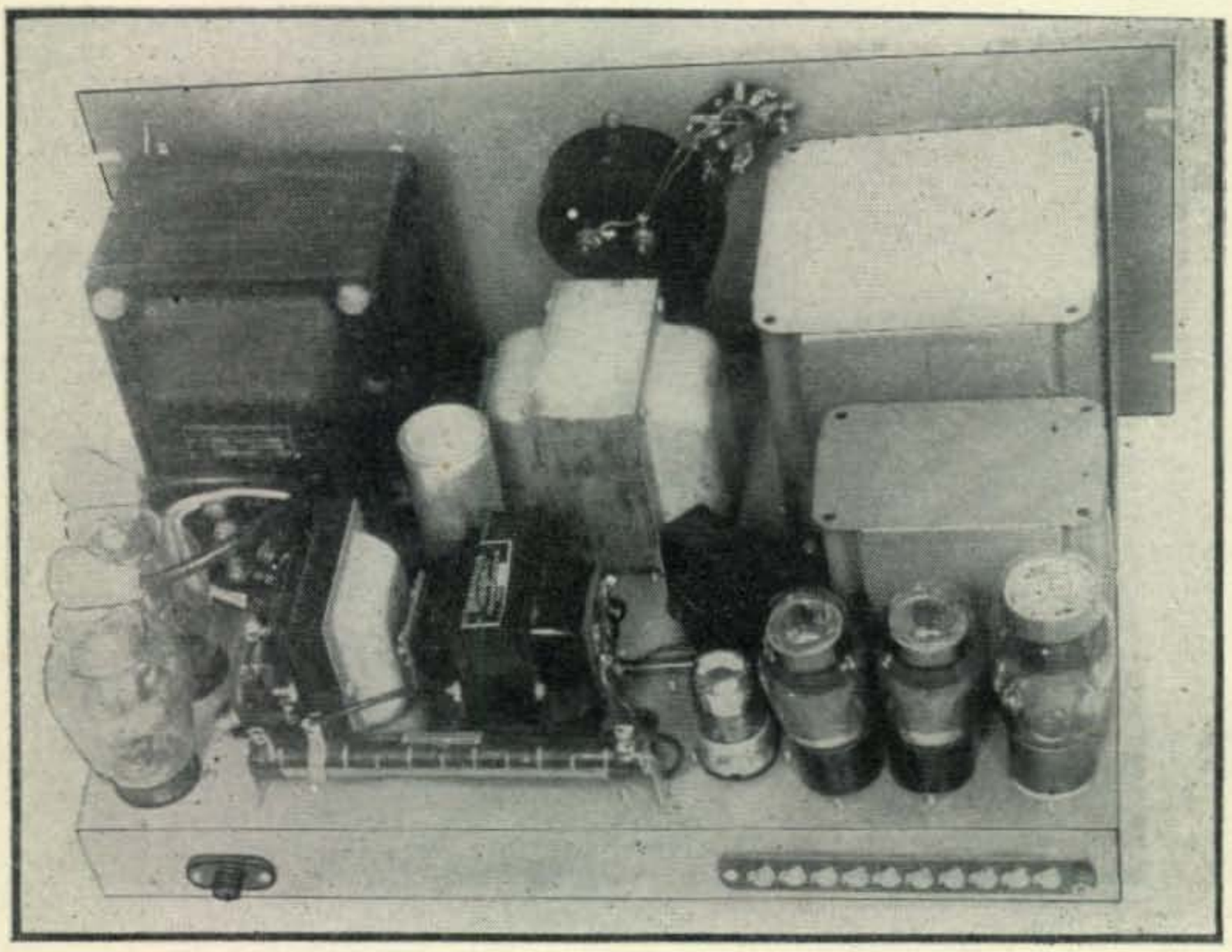
Medium Voltage Regulation

The third voltage regulator shown in the diagram uses 6V6's or other small power tubes connected as triodes in parallel to give a regulated supply to the exciter.

This voltage regulator draws no current when the cw key is closed since the grids of the regulator tubes are biased beyond cut-off value by the DC bias voltage generated in the final amplifier grid leak. When the key is open, no grid current flows in the final amplifier since no power is applied, so the regulator grids are grounded and the 6V6 tubes draw full current limited only by the cathode bias resistor. This resistor should be adjusted so the power supply voltage stays at approximately 250 volts for key-up or key-down condition. Since no regulator current flows when the power supply is loaded by the exicter, a saving in power transformer, choke and rectifier tube size is obtained. Good cw keying characteristics are possible even with a VFO. The 5R4GY rectifier is a high voltage version of the 5U4G.

The VFO plate supply has an additional voltage regulator, a VR75 in order to prevent line voltage variations from affecting the frequency control unit. The 6J5 and 6AC7 tubes are both connected to the 807 C bias supply to obtain blocked-grid keying bias. Keying shorts out this

[Continued on page 60]



Two separate power supplies with individual voltage regulators for all important stages are packed into this one chassis. Many of the ideas are applicable to any transmitter being built

GETTING ON THE AIR

From a Shoe Box

MAURICE K. BRETZFELDER, W2JPX

How many hams are faced with the problem of no place to put a rig? Eighteen pounds of transmitter in shoe-box size including everything from antenna relay to power supply is one solution to space difficulties. Designed for 5-6 meters this little rig is full of ideas for any band

THE WAR BROKE UP W2JCR'S family. The OM left home on Army-Navy work and the Junior Op joined the Navy. The XYL remained in New York City, but as a part of her own war conversion program, moved to a tiny apartment more suitable to her solitary needs. Came VJ-Day; and the OM's return found scant room for him. Larger apartments were not to be had—certainly no space for the rack-and-panel transmitter and sundry accessories of the pre-war days. He did manage to find room for an SX-17 and a 5-10 converter in one corner of the bedroom. Visiting them, I saw seven inches of vacancy on top of the receiver, and a glorious opportunity to bring a lost amateur back into the fold (incidentally having the fun of building a midget rig I had often thought about but never before saw an excuse to build).

Midget tubes were intriguing. Did a 6C4 have enough hop to be practical? Ten-meter crystals had possibilities, and diagrams were drawn with a twin-triode oscillator-doubler and a single-triode final. No harmonic trouble to bother 2½-meter services was contemplated if the final tank and antenna system were properly designed (despite the single-ended final). The tube selection was automatic. The 6C4 has more power handling ability than any other midget and the 6J6 is the only twin triode.

The oscillator-doubler circuit is one recommended by Bliley for use with a 10-meter crystal, but the cathode and grid resistors were reduced in value to suit the low grid voltage required by a 6J6. The by-pass capacitors were the largest in the junk box. A breadboard layout of this oscillator-doubler circuit had low output and a bad low-frequency para-

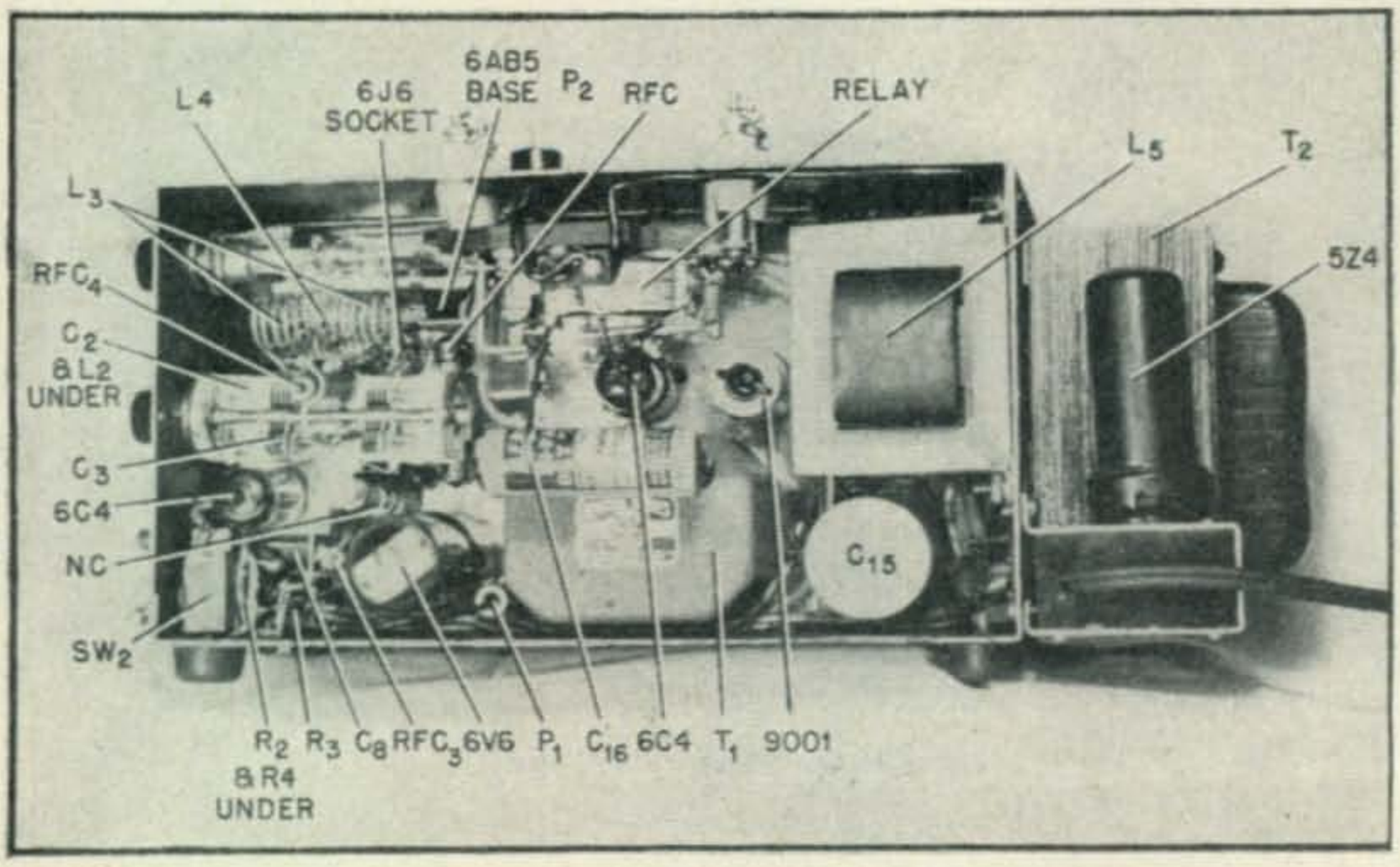
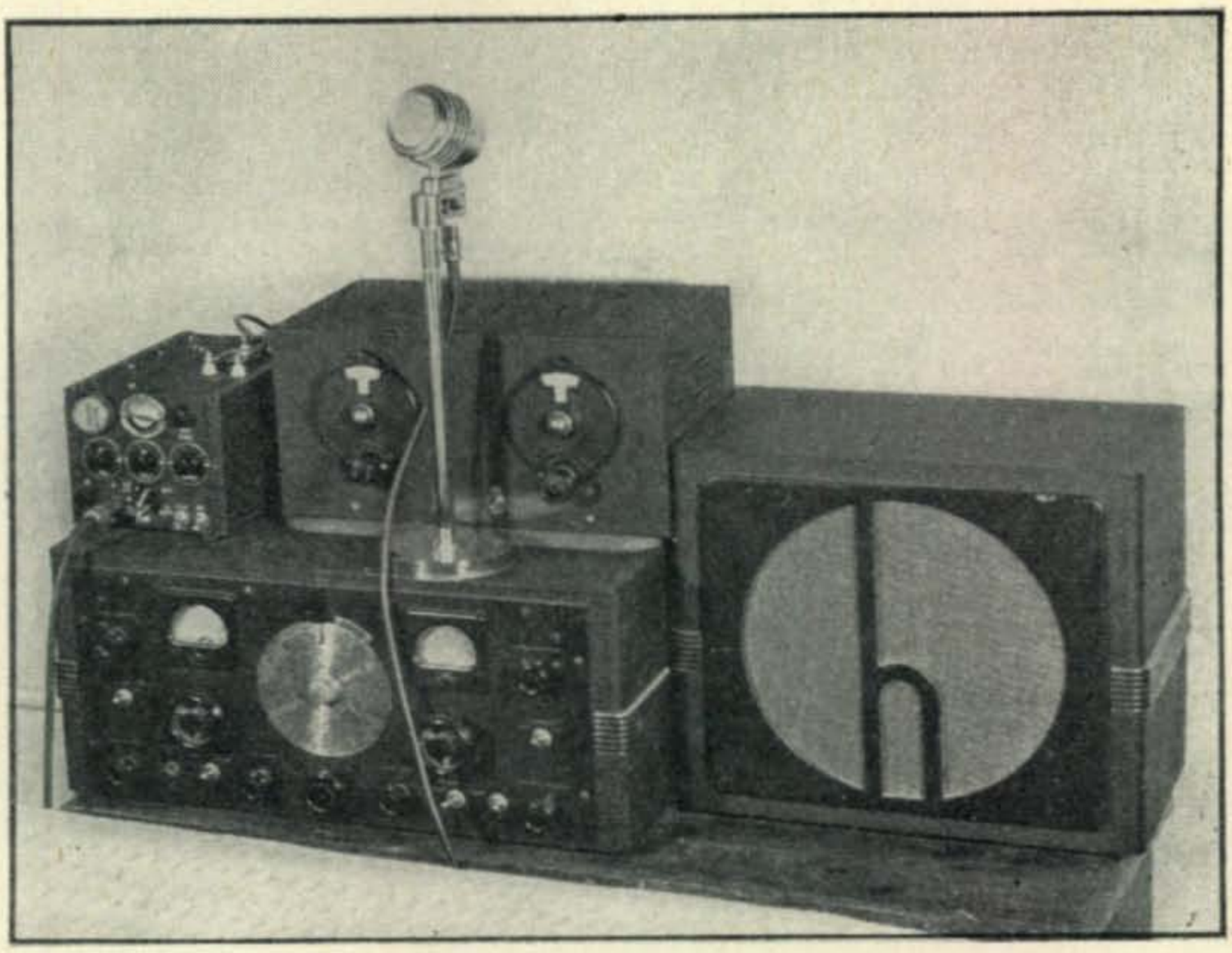


Fig. 2. Inside view with one side cover of cabinet removed. At left center is the final r-f stage. The doubler is hidden directly behind this stage. Note the "rear porch" mounting of the power transformer and rectifier to avoid internal heating



Smallest piece of equipment in the compact station of W2JCR is the shoe-box size transmitter

sitic. The parasitic was eliminated by cutting down the doubler-grid choke a quarter of a pie at a time until only 1½ pies remained. The grid and bias resistors were juggled until values were found which gave satisfactory output.

Cut and Try

The final stage was similarly laid out and proper resistor values determined by experiment. These were somewhat larger than the tube handbook calls for. By-pass and coupling capacitors are not critical. The final tank was designed to have a Q of six according to the charts available in *The Radio Handbook*, and a coil size found in one shot on the "Lightning Calculator." No midget meter was available to serve as the tuning indicator, so a 6AB5 indicator tube was used. It terminates in a pair of tips which plug into pin jacks on the front panel to provide indications in the doubler-grid, final grid and final cathode circuits. (A 6E5, with low plate voltage, might have been more sensitive, but none was available.)

When the rig was in the paper stage, transformerless plate supplies, both half-wave and voltage-doubling, had been considered, but no combination of modulator and transformerless supply (the low-voltage output of which would require at least two modulator tubes and possibly a modulator input transformer as well) was found as compact as the transformer and a single resistance-coupled 6V6 modulator. Moreover, it was felt that the higher voltage (and therefore the higher carrier output) fully justified this type of supply. Class B or AB for the modulator was out because of the large transformer required. A 2-stage high-gain voltage amplifier

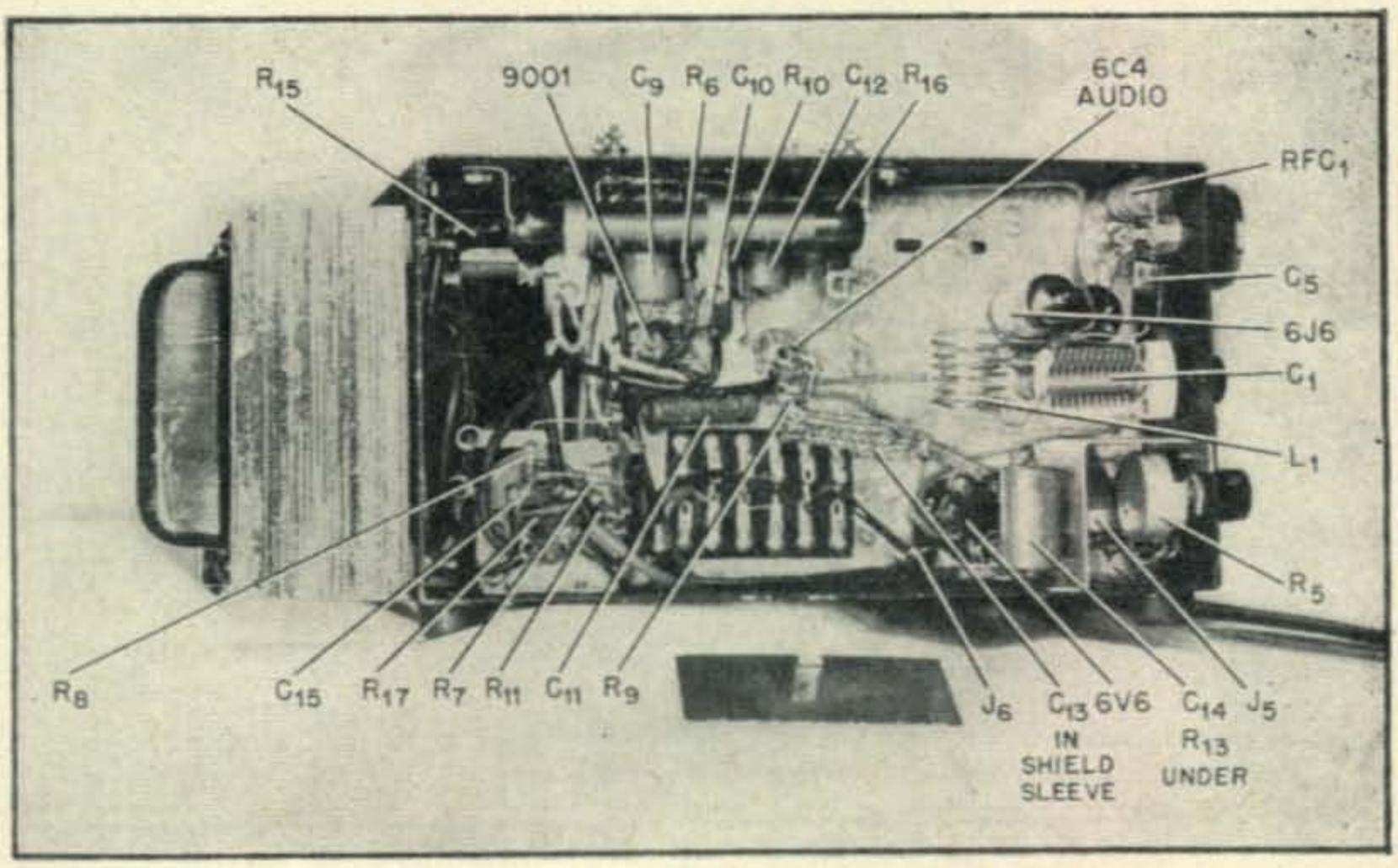


Fig. 3. Left hand side with cover removed. The oscillator tank circuit and oscillator-doubler dual triode are shown at front end. The bakelite heat baffle normally mounted behind bleeder R16 is shown foreground

was necessary to feed the modulator. W2JCR had only a low-level microphone and, moreover, this avoided the problems of input transformer and voltage supply for a carbon mike. The design of this voltage amplifier was straightforward, with a 9001 selected as the most suitable midget pentode.

Construction

A cabinet was secured, the power transformer installed (projecting through the rear end), and the size of the partition chassis figured so as to clear the transformer and filter capacitors. The multiple-section filter, C_{15}, could be most readily mounted by means of a fuse-clip type holder, but none was available. A metal shelf was mounted on the cabinet wall, just ahead of the power transformer, and the regular metal mounting plate, supplied with the capacitors, attached to this.

The chassis was made from 14-gauge aluminum with the edges bent up over a hardwood block. Three of these lips serve to mount the chassis to the top, bottom and front of the cabinet, while the lip at the rear lends rigidity. Details of the chassis are shown in *Fig. 1*. It will be noted that the front lip is only 1¾" long, the rest having been cut away to provide clearance for components mounted on the front panel. Next the slot for mounting the indicator tube was drilled, filed out, and the indicator tube assembly mounted. The chassis was then positioned in the cabinet so that the end of the indicator tube lined up with the vertical center-line of the front panel, and a hole cut in this panel to accommodate the tube. Then holes for mounting the chassis were drilled in the cabinet and chassis mounting lips.

The front panel and top of the cabinet were laid out and drilled for the various parts mounted thereon, including the 2-hole crystal socket and the bleeder ventilator holes in the top. The provision for mounting the crystal outside was, not only to facilitate changing crystals but, more important, to avoid heat. Well ventilated, and with low crystal current, the frequency drift of this rig proved to be negligible.

Putting the rectifier tube on the "back porch" saved internal space and reduced heating. The

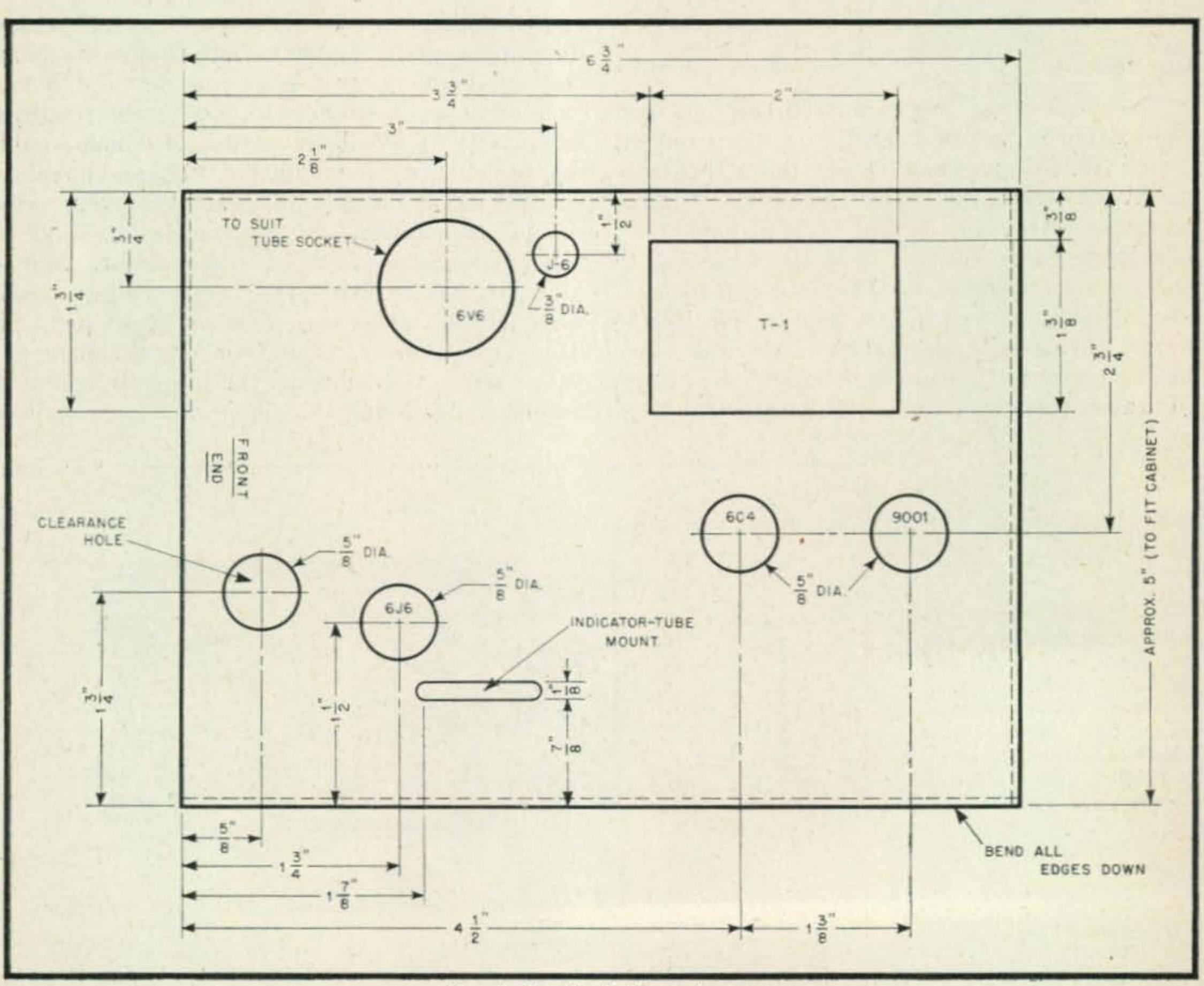


Fig. 1. Finished chassis layout

support consists of a piece of chassis metal 6 1/8" x 1 3/4", formed in a "U" shape with its ends bent up 3/8" to provide means for attaching it to the cabinet. Before bending, a cut-out for the rectifier socket was made in the top deck, after which a strip of bakelite was mounted in the open outer side of the "U" (as shown in *Figs. 2* and *3*) to anchor the line cord and enclose the socket connections.

Mounting the Works

The tuning and filter capacitors and other cabinet parts were next mounted so that clearance for the chassis components could be planned and the chassis laid out for drilling. The chassis was then removed, drilled, holes cut for the tube sockets and the latter mounted. The oscillator-doubler socket is located with its terminals on the side of the chassis with the indicator tube, while the three audio sockets are mounted just the reverse. After replacing and securing the chassis, the oscillator-doubler was completed, with the coils mounted directly on their respective tuning capacitors. (It might be pointed out that the new I.R.C. small type BTS ½-watt, and type BTA 1-watt resistors were used wherever suitable values were available.) Filament returns from each tube are brought through the chassis.

The entire final stage was built as a separate sub-assembly for installation by means of the one-hole mounting of the tuning condenser. The Hammarlund HFD-50 micro-condenser was the smallest to be found, but some modification was necessary. As purchased, its front and rear end plates are formed to serve as mounting feet. The front foot was cut off, the center shield discarded, and 2 fixed and 3 movable plates removed from each of the two sections. The screws holding the front end-plate were replaced with slightly longer ones so that these, and a screw run through the hole formerly used for mounting the discarded center shield, could be used for mounting the sub-chassis plate of *Fig. 4* on the under side of the isolantite base-plate. The tube socket is mounted on this plate and the coil directly to the lugs at the opposite side of the condenser from the tube. Lugs on the tube side are used for the connections to the tube plate and neutralizing condenser.

Front-panel antenna coupling adjustment was considered a "must." A midget jack was used as the panel bearing with a ¼" length of polystyrene rod as the shaft. A brass collar attached to the shaft bears against the rear of the jack-mounting assembly to retain the shaft in position. A long set-screw in the collar, striking the jack spring, serves as a stop in the position of maximum coupling. The coupling coil is

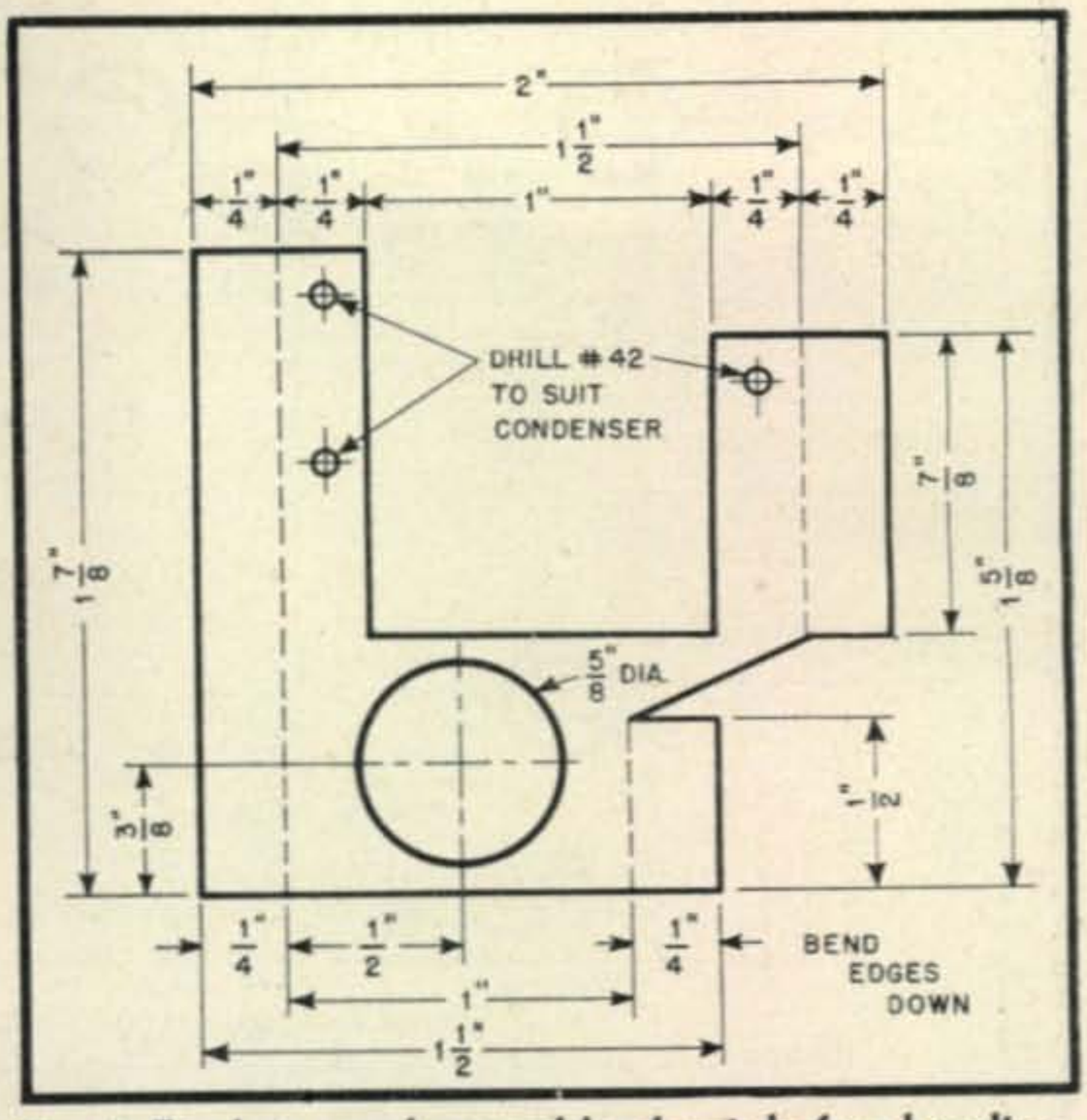


Fig. 4. Final-stage sub-assembly chassis before bending. Dotted lines indicate positions for bends

mounted on the shaft by running its leads through snug holes in the shaft, crimping them on the coil side and bending them over. When the flexible leads are soldered to these bent-over ends, the heat of the soldering softens the polystyrene and the leads are tightly locked in position when it cools. The neutralizing condenser was next screwed down on its stand-off insulator on the chassis. The grid and bias resistors were soldered to the pin jacks on the front panel. Then the sub-assembly was installed and wired.

Checking the R-F Circuit

The r-f section was now tested. Bias resistors were checked by shunting them with other values. It was surprising how critical these resistors were and how much their values differed between the mounted and the breadboard models.

The whole audio system was installed and wired in accordance with *Fig. 5*. The B+ connection to the modulation transformer goes to the terminals indicated in the diagram so that the d.c. in the primary bucks out the d.c. in the secondary. The formed shield partition around the microphone jack and gain control, as well as the braided shield inclosing the first-stage grid lead and the modulator coupling condenser, were included as a precautionary measure. This undoubtedly contributed to the fact that absolutely no radio-frequency feedback existed in the finished job. The bleeders came last, and a bakelite strip protects the voltage amplifier electrolytic by-pass condensers from the heat developed by the large resistor.

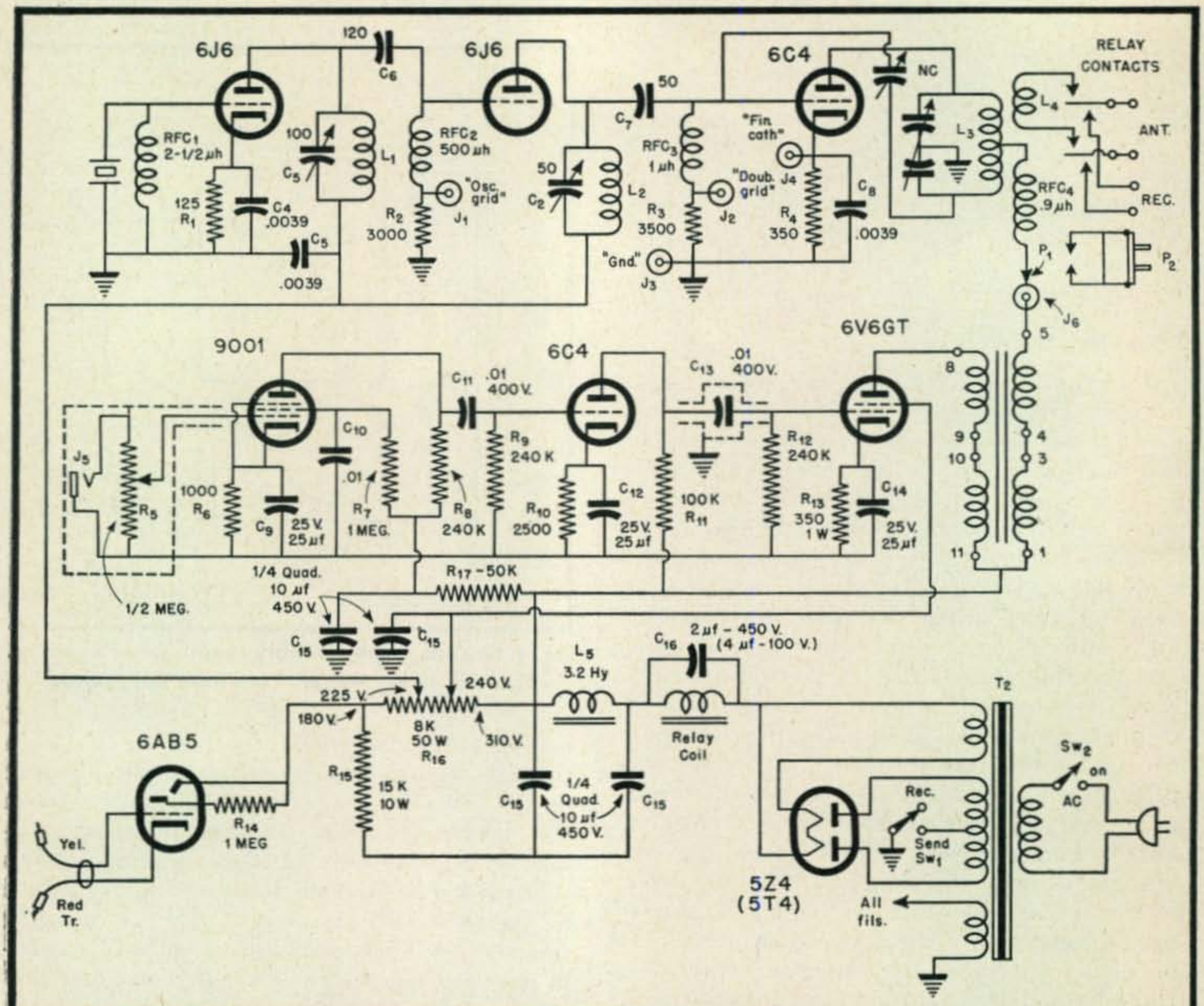


Fig. 5. Wiring diagram constructed with the following parts (equivalent products can be substituted):

C_1—100 μμf war surplus midget padder
C_2—50 μμf war surplus midget padder
C_3—50-50 μμf modified Hammarlund HFD-50
C_4, C_5, C_8—.0039 μf mica pigtail
C_6—120 μμf mica midget
C_7—50 μμf mica midget
C_9, C_{12}, C_{14}—25 μf, 25 volts pigtail electrolytic
C_{10}, C_{11}, C_{13}—.01 μf 400 volts paper
C_{15}—4-section prong type, 20 μf per section, 450 volts d.c. working. Mallory #444 electrolytic
C_{16}—2 μf 450 volts Aerovox PR-5 electrolytic
J_1, J_2, J_3, J_4, J_6—Bakelite tip jacks
J_5—midget 'phone jack
L_1—6 turns #14, 7/8" dia. length 1 1/8"
L_2—4 turns #14, 7/8" dia. length 1 1/8"
L_3—10 turns #14, 1/2" dia. length 1 3/8" in two sections spaced 3/8" apart
L_4—3 turns #18, 1/2" dia. length 3/16" to clear gap between sections of L_3
L_5—8 henry 150 ma choke, Stancor #2309
NC—neutralizing capacitor National NC-600U ceramic
P_1—insulated 'phone tip
P_2—miniature connector plug and receptacle, Alden #502PC-502FC
Relay—Leach (see text)
R_1—125 ohms, 1/2 watt
R_2—3,000 ohms 1/2 watt
R_3—3,500 ohms 1/2 watt
R_4, R_{13}—350 ohms 1 watt
R_5—500,000 ohms midget potentiometer, audio taper
R_6—1,000 ohms 1/2 watt
R_7—1 meg. 1/2 watt
R_8, R_9, R_{12}—250,000 ohms 1/2 watt
R_{10}—2,500 ohms 1/2 watt
R_{11}—100,000 ohms 1/2 watt
R_{14}—1 meg. (in magic eye assembly)
R_{15}—15,000 ohms 10 watts
R_{16}—8,000 ohms 50 watts, adjustable
RFC_1—2 1/2 mh National R-100
RFC_2—2 1/2 mh National R-100 (see text)
RFC_3, RFC_4—5-meter r-f choke Ohmite type Z-1
S_1, S_2—SPST toggle switches
T_1—UTC F-18 universal 12-watt output (modulation) transformer
T_2—war surplus transformer, half-shell type, 380-0-380 volts, 125 ma, 6.3 volts, 5 volts

MISCELLANEOUS

Middletown UC-596 cabinet, steel utility, 6" x 5" x 9"
Amphenol magic eye assembly #58-MEA-6 (base plate not used)
10-meter crystal
Amphenol #54-2 crystal holder socket
Amphenol polystyrene miniature sockets #54-7P (2)
Amphenol octal sockets #54-88 (2)
Bakelite miniature socket, 7-prong
Bakelite miniature socket, 7-prong with short shield
Millen #32102 feed-through bushings for 1/4" holes (4)
ICA #2259 dial plates, 1 1/2" dia. (3)
ICA knobs #1081 (5)

An antenna change-over relay was required with an additional contact which would be closed in the "receive" position. This was made from a DPDT relay having an extra contact normally open. With some scrap bakelite, the open contact was reversed to normally closed, and the whole relay mounted on polystyrene and supported by midget feed-through insulators. Because the supply voltage was a bit high for miniature tube ratings, it was decided to use the total d-c supply current to operate the relay, thus reducing the supply voltage by the amount of the drop across the relay. This worked beautifully except for a bad chatter, which was readily cured with a smoothing capacitor. The polystyrene base unfortunately melted. The old bakelite base was cut down as small as possible—leaving just enough to support the coil and contacts. Holes were

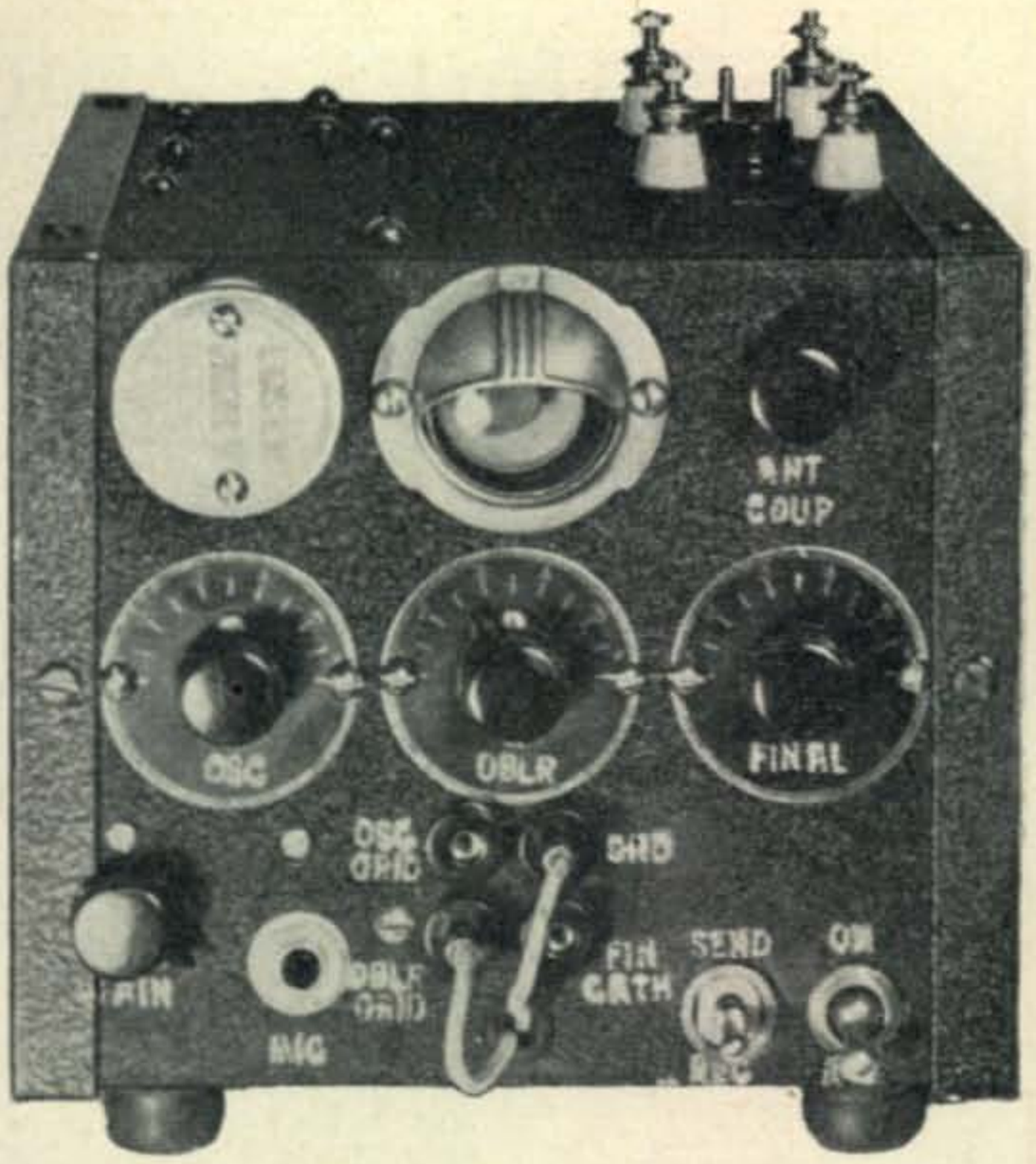


Fig. 7. the 5" by 6" front panels contain all operating controls. Relay terminals for antenna receiver and automatic send-receive control of receiver are on the top, out of the operator's way

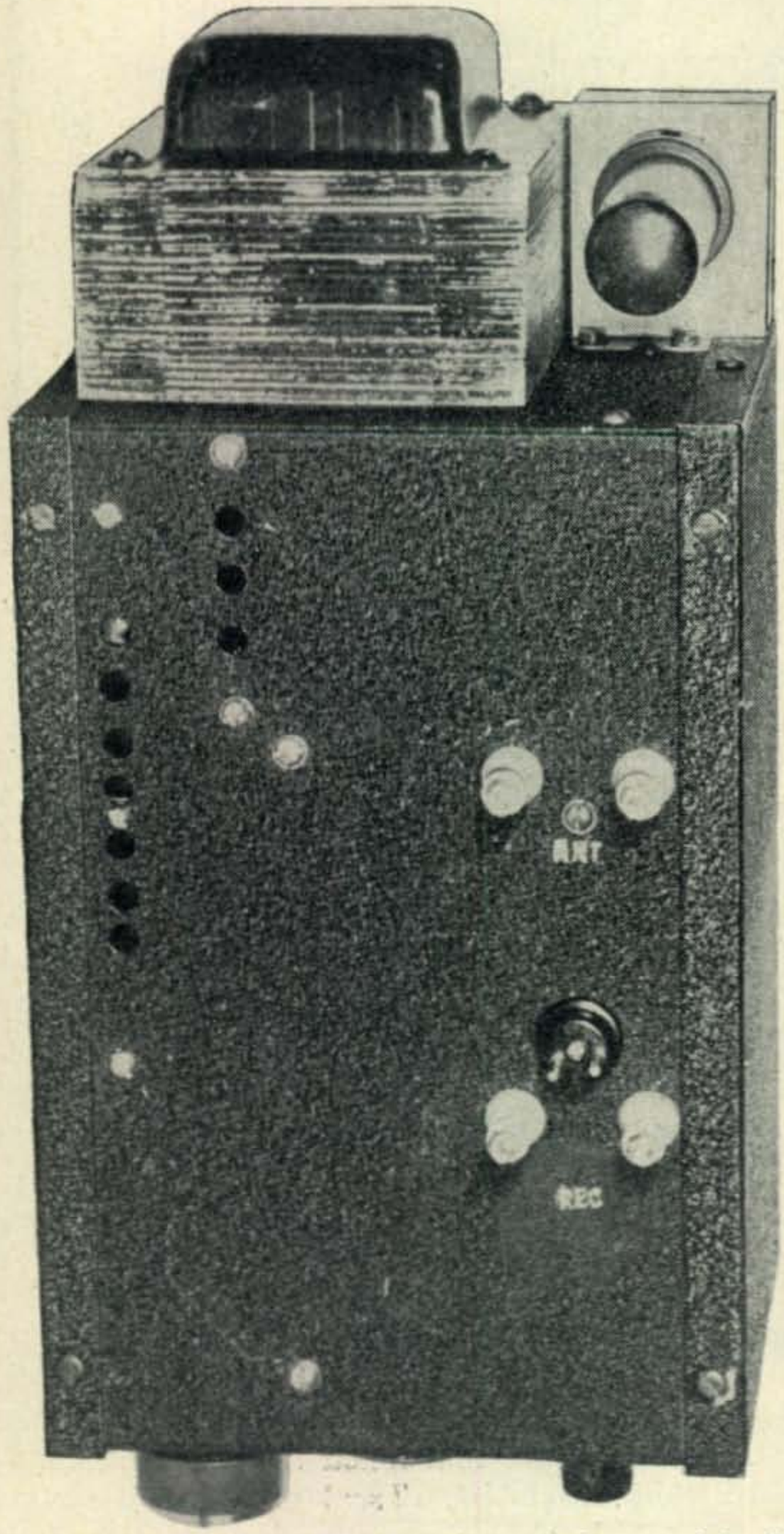


Fig. 6. Top view. Note ventilating holes over bleeders R15 and R16 and receiver standby connection plug

bored in it to reduce the amount of dielectric in the field, and the movable contacts were attached directly to the standoffs on the cabinet top. An alternate set-up for the relay would be to use it on the a-c line, controlled from a switch at the receiver, with the normally open contact closing the B supply to the transmitter. In this event a resistor of 25 or 50 ohms should be connected in series with the B+ lead between the rectifier and the first filter condenser to hold down the voltage. Midget tubes will not stand severe overloads.

Finishing Touches

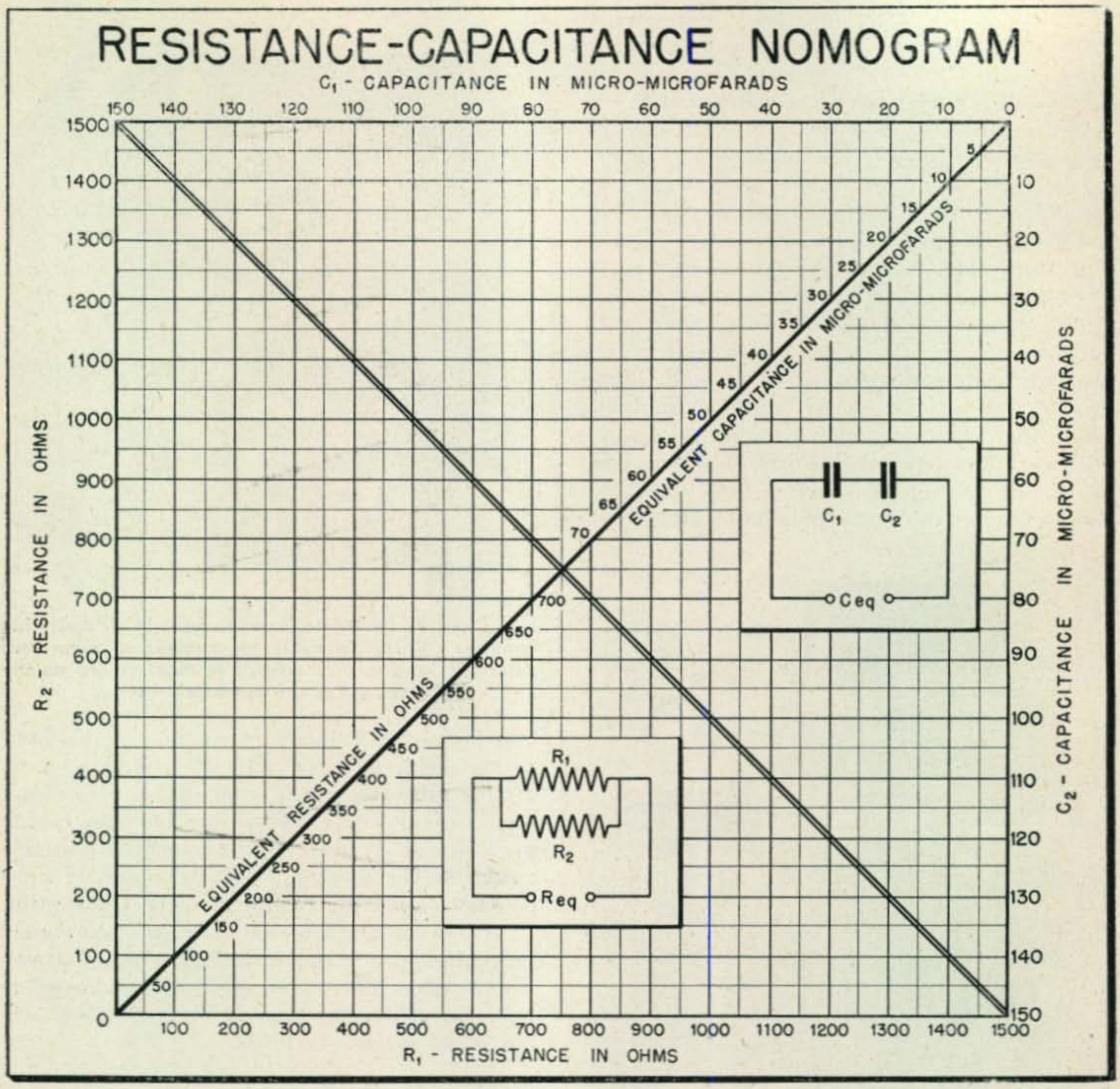
As a final construction step, a removable-letter rubber stamp set was used for marking the front panel and cabinet top. A white-pigmented shellac was lightly brushed over the face of the rubber letters with a felt pad, and the labels then stamped. (An error was made in stamping the pin jacks. The one marked OSC GRID should have been marked FINAL GRID. The correct terms are used in tuning instructions.)

Proper voltages were determined by adjusting the bleeder values and sliders. Those found most satisfactory are shown at the bleeder connections in the schematic diagram, *Fig. 5*.

Tuning

In tuning and adjusting, the indicator cathode-lead tip is first placed in the GROUND jack and its grid lead in the DOUBLE-GRID jack.

[*Continued on page 59*]


RESISTANCE-CAPACITANCE NOMOGRAM
C1 - CAPACITANCE IN MICRO-MICROFARADS
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0
R2 - RESISTANCE IN OHMS
EQUIVALENT RESISTANCE IN OHMS
EQUIVALENT CAPACITANCE IN MICRO-MICROFARADS
C2 - CAPACITANCE IN MICRO-MICROFARADS
R1
R2
Req
C1
C2
Ceq
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
R1 - RESISTANCE IN OHMS

RESISTANCE-CAPACITANCE NOMOGRAM

This dual chart solves the illustrated combinations of resistances in parallel, or of capacitances in series. The lower half of the nomogram is for resistance, and the upper half for capacitance.

To solve a parallel resistance circuit, lay a ruler across the outer resistance scales, connecting the known values of R_1 and R_2. Then the equivalent resistance may be read at the intersection of the ruler with diagonal resistance scale.

To determine the equivalent capacitance of two capacitors connected in series, the upper portion of the nomogram is used. Lay a ruler across the scales, connecting the known values of C_1 and C_2. Then the equivalent capacitance may be read at the intersection of the ruler with the diagonal capacitance scale.

The chart is useful in other problems. For example, if it is required to make up a parallel combination of resistances with a specified equivalent resistance, the chart may be used as follows: Place a ruler at the desired equivalent capacitance on the diagonal resistance scale, and swing the ruler about this point as a pivot. Then all possible combinations of resistance to make this equivalent value will be seen along the outer resistance scales.

The capacitance scales may be used in entirely analogous manner.

Note that the chart is good for larger and smaller values than appear on the scales; that is, if *all* scales are multiplied by 10, the chart is still valid. Likewise, *all* scales may be divided by 0.1, or by 0.01, or multiplied by 100, or 1000.

W2JPX and W2JCR look over their tiny 5 meter transmitter. Both are now busy explaining to the XYL that the big rig in the background is *absolutely* necessary

DEPARTMENTS

- *Calls Heard*
- *CQ DX*
- *Parts and Products*
- *Club News*
- *Postscripts and Announcements*

Calls Heard

Send all contributions to Calls Heard Editor, CQ

HEARD IN PORT WASHINGTON, N.Y.

Howard Langerman, W2LBJ

28 megacycles 2-1-46

XE1D W9GFG/K6 W8BOR/PY

28 megacycles 2-2-46

XE1AG XE1KM XE1A TG9WPB
ZS4AA

28 megacycles 2-3-46

D4ABL D4ABG D4ACT D4AAG
G6WU G6YJ G4JV G8TH
G4CI G2MI G2TA G8WL
G8TD G6WY G6QB ZS6DW
ZS6FN CO2RG XE1JF XE1D
W1HCH/K6 W9BOC/K6 K6ROJ
W2LEV/K6 LU7EZ W6RMJ/PY7

28 *megacycles* 2-4-46

G8RN G6NF GW5XN GM3YX
G6RL G2TA G5BM

28 megacycles 2-9-46

G3YZ.

HEARD ABOARD USS LAKE CHAMPLIN IN ENGLISH WATERS

Commander E. H. Conklin, W3JUX/W9BNX

28 megacycles 12-6-45

A3

EA1D I1MC W2JRE W3FTR/3
W3FTX W3GLV W3MV W3NA
W3IU W4EDF W4FLT W4HKJ
W8DFN/3 W8GFN/3 W8KYY W8LO/2
W8QUL W8RDX W8RL W8RDR
W8RTX

K4ESH W8AL W8AII W8PEN
W8SDD W9ECC W9PK W9TCZ

28 megacycles 12-16-45

A3

VE1ER VE3AA VE3AGP W3AIB/3
W3BES W3BVL W3CBT W3DGM
W4EDW W4EYN W4FIT K4HQJ
K5HTC W8AXN W8AYY W8EPN
W8FPG W8KFC W8LAI W8NYB

W8PAN W8RLT W8UJR W8WNP
W9BEB W9EMX W9EXT W9FS
W9LOG W9MPQ/K4 W9NDK W9QCD
W9VIM

A1

VE3YY W9FS

28 megacycles 12-17-45

A3

W1JMQ W1JSU/6 W3BSO/9 W4DRZ
W4FBU W4HGO W6AGS W6EAW
W6KPA/9 W6JJU W6PIQ W6TQW
W8AJM W8EUQ W8KJ W8PBR
W8QGZ W8UGA W8UJL W9CCB
W9CII W9DNL W9DXX W9EMQ
W9EDR W9FGR W9FKQ W9HSQ
W9IOJ W9IUK W9KPW/8 W9LEQ
W9QIX W9RMN W9USU W9VJD
W9ZHB

A1

W4CDC W9SEY VE3MY

28 megacycles 12-18-45

A3

VE3OO W2GFH W2MA W3CLA
W3FPX W3IU W4FPB W4HPO/4
W5FRD W5HRW W5HYZ W5IRT
W5JIU/6 W5JW W5KJB W6AYZ
W6GIK W6HG W6OZC W6OZH
W6OW W6SJP W6TIK W6WB
W7GDX W7GOH W7HAY/6 W7HDS
W7HIK W7HOE W7IGN K7IVS/6
W7KO W8AXN W8BTL W8DOR
W8EUQ W8FJD W8GOV W8HEC
W8MC W8OJF/8 W8RGW W8SGX
W8UJL W8UJR W8WOA W8WOH
W8WSV W9CJV W9CE/9 W9DZB
W9DJJ W9ERE W9EUA/9 W9IFB/9
W9JWF W9KFS W9KSS W9KW
W9NXE W9ORA W9QYW W9QCD
W9QRW W9UCU W9WIP W9YQV
W9ZNA/6 W9ZNP W9ZHB

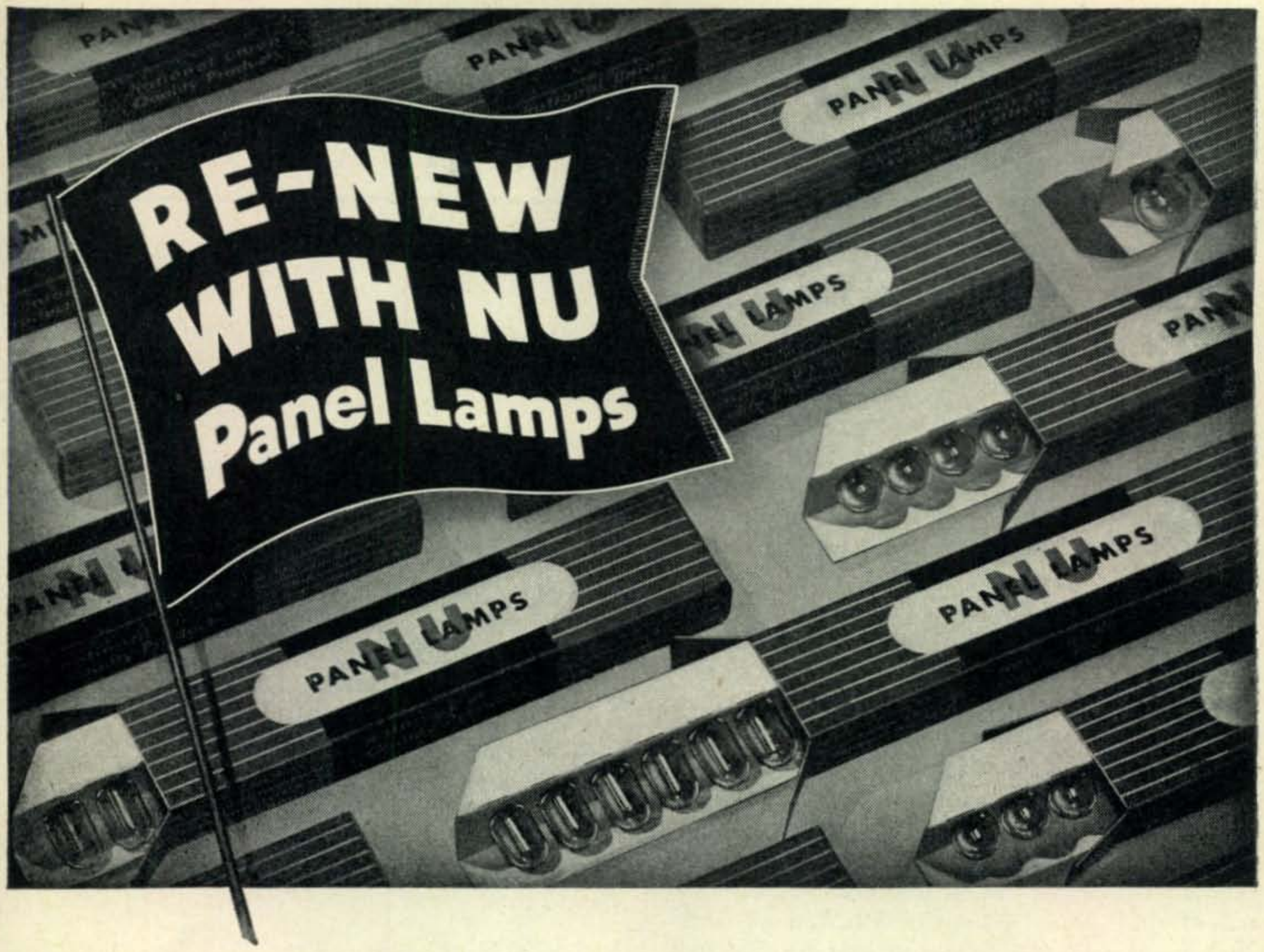
A1

W4HWT W6QQH W8JVI W9ZXX

HEARD IN SANTA MARIA, AZORES

Lawrence LeKashman, W2IOP

[Continued on page 52]



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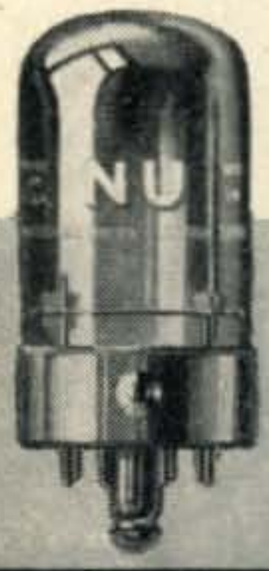

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CQ DX

By HERB BECKER, W6QD

[Send all contributions to Herb Becker, 1403 South Grand Ave., Los Angeles, 15, Calif.]

DX

Not everyone in ham radio is a DX man, but some of this particularly ardent form of amateur claim it is only because they can't work the stuff. Whatever the case may be, DX conducted by Herb Becker, W6QD (who has worked a little bit of it in his own day) will try to bring the latest rumors, frequencies, and general information on this highly complex subject. Mr. Becker might even be induced to give his own private recipe for obtaining rare QSL cards. In fact, one prominent East coast DX man said we should call the column "QSL"—that more fellows would want to read about the magic formula than what some other lucky guy in an A-1 location, with ten acres of land, plus a West Coast KW worked (at which point someone yells sour grapes). Lots of interesting stuff is being worked already, so if you can't work it . . . read about it anyway in DX.

WAZ

CQ is in no way affiliated with the old *Radio* which is now a professional engineers book. However the idea of continuing the *Worked All Zones* award is intriguing. It is up to the DX men themselves. If sufficient interest is shown, WAZ will be revived immediately. The question is should we start from scratch or take up from the pre-war days. With the DXCC wiping the slate clean, perhaps WAZ might do the same out of fairness to the newcomers in the DX ranks. There is also the question of whether or not the 40 zones should remain as defined before the war. If the zones are changed there is the awful possibility that some would-be DX editor might classify his QRA as Zone 40. Give it some thought and we'll get the ball rolling.

What's DX?

So many years have passed since any kind of operating on the ham bands that working a W9 is *really* something for 6QD. Stuff like G's, D's, K6's, and other "ordinary" contacts are now fought over like AC4YN. Talking about AC4YN . . . you may have noticed on the February cover of CQ a photograph of W2JIH who worked AC4YN on 28 Mc. January 6 was the red-letter day, with JIH receiving an S8 plus report. What makes it even more embarrassing (to the CW men) was the fact that it was two-way phone. Jimmy brushed up on his Tibetian during the war just to make this contact.

W2DWG made WAC on 28 Mc in 2 hours 35 minutes, between 7 and 9:35 AM on Feb. 10. Stations worked were XU3IK; ZS1AX; VK3MO; W6RNJ/PY7; G5LJ; W2LHF.

Henry Smith, CP1AA, ex-CT2BK, who kept many a DX'er burning midnight oil is now installing a chain of point-to-point stations in Brazil for I. T. & T. His wife and family are with him in Rio, where he may get on the air again.

Henry Smith
CP1AA

W2VL spent 31 months overseas doing radio work as an Army Major. This isn't a record, but when a guy comes home and pounds brass on his furlough to the tune of 475 contacts in four months of resumed amateur activity . . . .? Included in this list is some plain and fancy DX like W2KMZ/EL (Liberia). Other stuff snagged by W2VL: K4, K6, K7, VP2, VP4, PY, XE, KB6, ZS, G, VE, and of course a couple of W's. One day 2VL got caught off base and was heard working a W1 of 112 Mc.

Some of the stuff being heard on 20 is enough to make a real DX man break down and cry . . . or maybe crank up on 20. Take a gander at Calls Heard and you'll see what we mean. The day that 20 opens all those guys will QRT or be on their way home. Well things are tough everywhere.

[Continued on page 56]

Introducing the ULTRAPHONE

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Get on the air with this high quality 144-148 megacycle transmitter-receiver—designed for portable, mobile or fixed station use—

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- √ Expanded band spread and increased sensitivity.
- √ Transmitter will handle 30 watts input continuously.
- √ Operating capabilities up to 250 mc.
- √ Transmitter features the Taylor TUF-20 tube.
- √ Other tubes include 6AK-5, 7B4 and 7C5.
- √ Provisions for crystal or magnetic headphones and metering.

Comes complete with matched set of tubes, but less power supply. Will operate from 6-volt vibrator pack, genemotor or a-c power supply.

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Parts and Products . . .

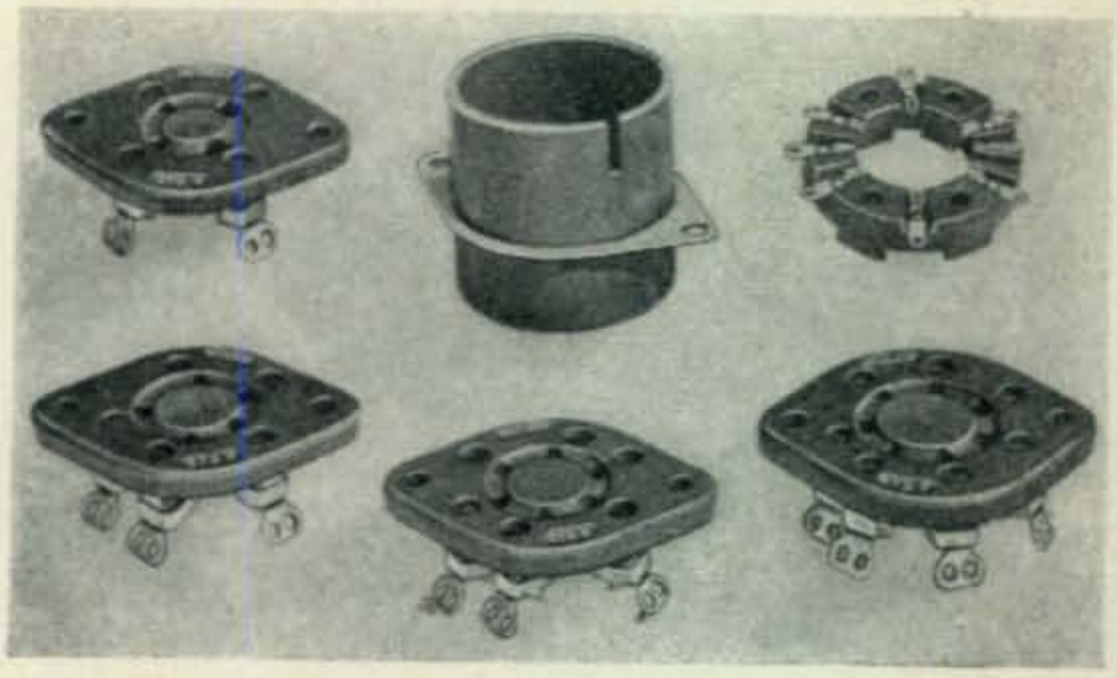
HIGH FREQUENCY TUBE SOCKETS

A series of new transmitting and receiving tube sockets molded of *Mykroy*—mica ceramic high frequency insulation has been developed by Electronic Mechanics, Inc., of Clifton, New Jersey.

Included in this new series are: standard 4, 5, 6 and 7 prong type—Octal and Loctal sockets for multi-prong tubes—also 5 and 7 prong Acorn sockets—4 prong high voltage rectifiers sockets and improved heavy duty "50 Watters."

The sockets are produced by compression molding and are of one-piece construction featuring spring phosphor bronze contacts anchored to the sockets by a method which assures rigid non-turning position. Top surfaces are perfectly flat and smooth to permit unimpeded mounting beneath chassis. Patented spring action clips provide firm, unvarying, highly conductive contact with tube terminals.

Mykroy sockets afford many advantages, particularly in the field of high frequency.



Mykroy is a greatly improved glass-bonded mica ceramic insulation which will not carbonize or otherwise deteriorate in the presence of high heat or electric arcs and flashovers. Thus no leakage paths will form between terminals, especially where high voltages are involved. High physical stability assures permanence of form and non-warping properties. *Mykroy* is impervious to oil, gas and water

New compact and complete Kluge "California Kilowatt," a 1000 watt amateur station that has the appearance of a desk. Featured in this design is a 5 band variable frequency transmitter, phone or c.w., provisions for any make receiver, built-in frequency monitor, world time clock, an illuminated world map

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*PLASTICONS—

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1	1000	2 3/8" x 1¾" x 1"	3.65	2.19
2	1000	3½" x 2" x 1¼"	4.70	2.82
4	1000	4 5/8" x 2½" x 1 3/16"	5.85	3.51
6	1000	4 5/8" x 3¾" x 1¼"	7.65	4.59
8	1000	4 5/8" x 3¾" x 1¾"	8.40	5.04
1	2000	2 3/8" x 2" x 1¼"	5.20	3.12
2	2000	3½" x 2½" x 1 3/16"	6.10	3.66
3	2000	3½" x 3¾" x 1¼"	7.50	4.50
4	2000	3½" x 3¾" x 1¾"	8.40	5.04
1	3000	4" x 2½" x 1 3/16"	11.00	6.60
2	3000	4" x 3¾" x 1¼"	14.00	8.40
4	3000	4 5/8" x 3¾" x 1¾"	19.35	11.60
1	4000	4" x 3¾" x 1¼"	25.00	15.00
1	5000	4" x 3¾" x 1¾"	30.00	18.00
2	5000	3½" x 3¾" x 4 9/16"	37.50	22.50
1	7500	3½" x 3¾" x 4 9/16"	45.00	27.00
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and possesses electrical characteristics of the highest order. It has high dielectric strength combined with low power factor and its leakage resistance is unusually high. Unlike many other ceramics it can be drilled, tapped and machined by conventional methods where modification is essential to chassis requirements. This feature makes it of particular interest to amateurs.

An eight page bulletin containing complete information and fully illustrated with sockets, tube parts and accessories, dimension data and charts showing Electrical, Mechanical and Physical Properties is available free upon request to CQ Parts and Products Department.

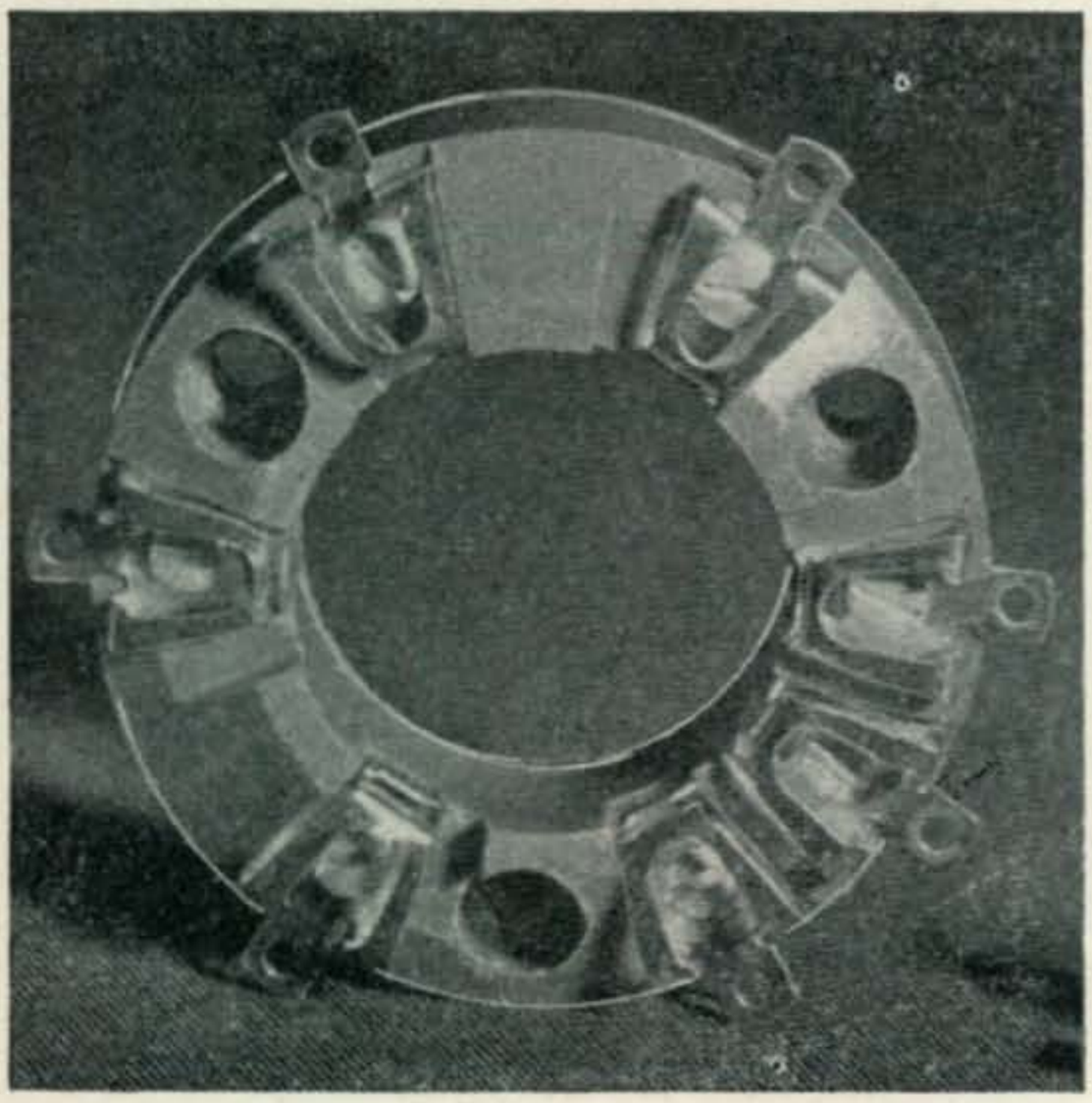
ACORN SOCKET

The National Radio Company Malden, Mass., has announced the release for civilian use of the XLA socket and associated components, which were developed during the war.

The announcement is of interest to UHF enthusiasts who have long felt the need of a socket which would not subject the relatively expensive acorn tubes to undue strain. In ordinary sockets, the strain is in the direction where the glass is weakest. In the XLA, which is inserted sideways by twisting, the strain is in the direction where the glass is strongest, or around the circumference.

One of the components is the XLA-S, which is a silver-plated shield for pentode acorns, and is used with the XLA socket. This also provides a mounting base for the socket.

Another component is the XLA-C, a special ceramic condenser, which may be mounted inside the socket in place of the contact screw. National officials said these are available in a variety of capacities. Standard values are 100 $\mu\mu$f., 50 $\mu\mu$f., 25 $\mu\mu$f., and 7 $\mu\mu$f.



Seven contacts are provided so that the new 6F4 can be accommodated in addition to the popular 950 series, requiring 5 contacts.

TAYLOR TB-35 U.H.F. BEAM TETRODE

A new U.H.F. beam tetrode, termed the Taylor TB-35, has been added to the well-known line of Taylor Tubes, Inc.

Operating with full power input up to 250 mc and at half-power input to 400 mc, the tetrode fills a definite need for a tube with a power output of over 125 watts (Class C, telegraphy) in these ultra high frequency regions.

Taylor TB-35
U. H. F. Beam
Power Tetrode

The tube possesses a four-pin ceramic base and the plate connection is brought out at the top of the envelope. The overall size of the tube is 4 7/8" and the maximum diameter is 1 5/8".

Electrical characteristics: Filament, thoriated tungsten, 6.3 volts (a-c or d-c) at 3 amps; Mu—65 approx.; Mutual conductance at Ib .08—2750 micromhos; Interelectrode capacitances—Input to plate 0.2 $\mu\mu$f, Input 6.5 $\mu\mu$f, Output 1.8 $\mu\mu$f.

Typical operation, Class C telegraphy: d-c plate volts—1500; d-c grid No. 1 volts—300 volts; d-c grid No. 2 volts—375; d-c plate current—110 ma; d-c grid current—15 ma (approx.); d-c screen current—22 ma; Plate dissipation (max.)—35 watts; Peak r-f grid input volts—350 (approx.); Driving power—4.5 watts (approx.); Plate power output (to 250 mc)—130 watts.

Typical operating conditions, Class C, plate

[Continued on page 54]

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"The Standard of Comparison"

Of construction and quality unmatched by meters selling at far higher prices . . . giving performance exceeding that of three separate instruments costing nearly four times its price . . . it is no wonder we are told that "VOMAX" is today the standard of comparison.

"VOMAX" is new . . . different . . . and outstandingly superior . . . because it is a brand new **post-war** v.t.v.m. . . . and truly universal. With "VOMAX" you can measure **every** voltage required in radio servicing . . . even in the design laboratory. Not only does it enable you to measure d.c. and a.c. voltage at meter resistance so high as not to effect the circuit being measured, but "VOMAX" at last lets you measure a.f. and r.f. voltages from 20 cycles to over 100 megacycles . . . resistance from .2 ohms through 2,000 megohms is "duck soup" with "VOMAX" . . . as is direct current from 50 microamperes through 12 amperes.

Add to all this new visual dynamic signal tracing . . . direct measurement of **every** voltage from receiver antenna to speaker voice coil . . . and you know why many government departments, serious industrial, radio engineering, university research laboratories . . . and service technicians by the thousands clamor for "VOMAX".

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Measures EVERY Voltage

1. Brand new post-war design . . . positively not a "warmed-over" pre-war model.
2. More than an "electronic" voltmeter. VOMAX is a true vacuum tube voltmeter in every voltage resistance db function.
3. Complete visual signal tracing from 20 cycles through over 100 megacycles by withdrawable r.f. diode probe.
4. 3 through 1200 volts d.c. full scale in 6 ranges at 51 and in 6 added ranges to 3000 volts at 126 megohms input resistance. Plus-minus polarity reversing switch.
5. 3 through 1200 volts a.c. full scale in 6 ranges at honest effective circuit loading of 6.6 megohms and 8 mmfd.
6. 0.2 through 2000 megohms in six easily read ranges.
7. — 10 through + 50 db. (0 db. = 1 mw. in 600 ohms) in 3 ranges.
8. 1.2 ma through 12 amperes full scale in 6 d.c. ranges.
9. Absolutely stable—one zero adjustment sets all ranges. No probe shorting to set a meaningless zero which shifts as soon as probes are separated. Grid current errors completely eliminated.
10. Honest, factual accuracy: ± 3% on d.c.; ± 5% on a.c.; 20 ~ through 100 megacycles; ± 2% of full scale. ± 1% of indicated resistance value.
11. Only five color-differentiated scales on 4 3/8" D'Arsonval meter for 51 ranges (including d.c. volts polarity reversal) eliminate confusion.
12. Meter 100% protected against overload burnout on volts ohms db.
13. Substantial leather carrying handle. Size only 12 3/8" x 7 3/8" x 5 3/8"

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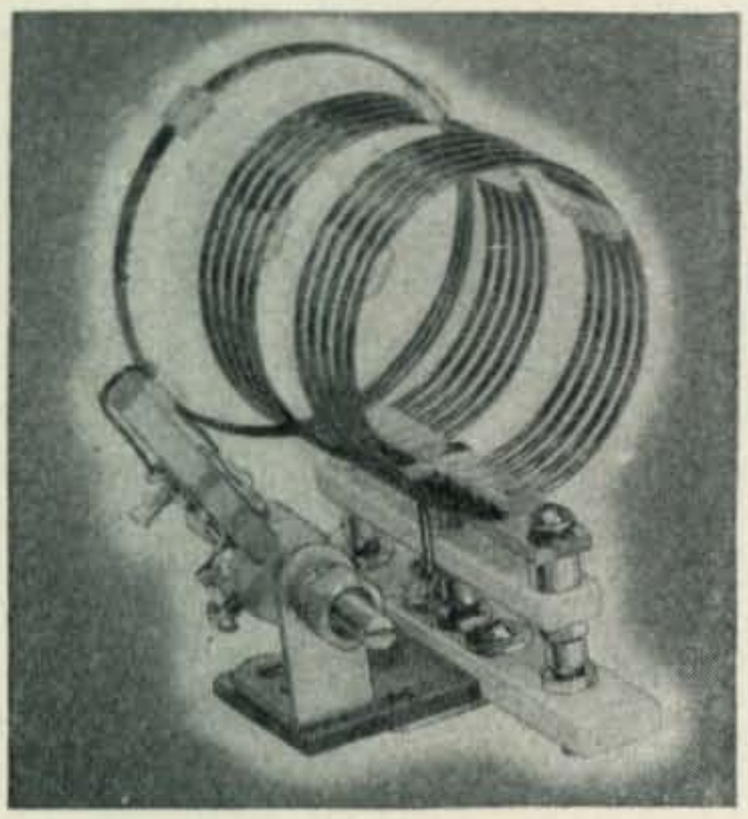
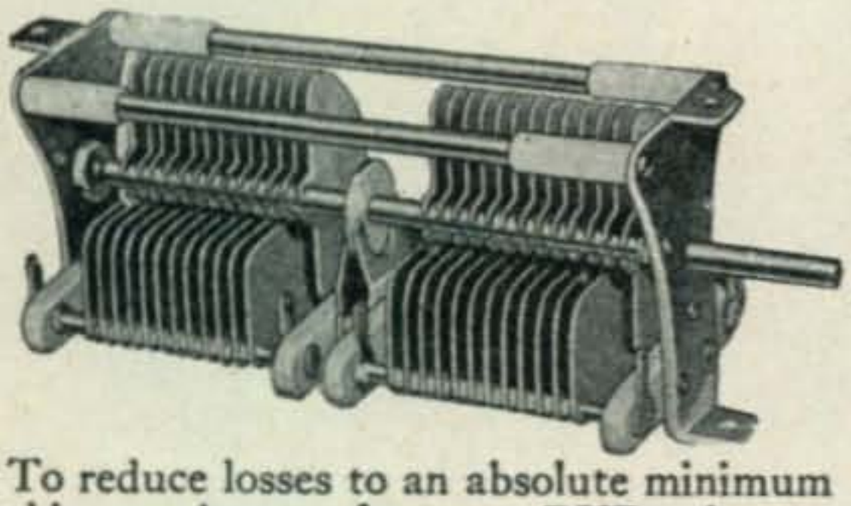
but not for long!

The final condenser arced over and blew out the rectifiers. Had he used BUD scientifically produced components the log entry would not have read "transmitter broke down!"



All coils are of the air-wound type to promote efficiency. The use of a variable link to the plate tank as a means of varying the loading of an R.F. stage is effectively utilized in this type of inductance.



To reduce losses to an absolute minimum this condenser features BUD electro-soldered plate assemblies. This assures correct plate spacing, overall rigidity, and light weight.

BUD

BUD RADIO, INC.

CLEVELAND 3, OHIO

Club News

The first post-war hamfest in Ohio was held Thursday, December 6th, in Cleveland by the Cuyahoga Radio Association. Over 300 active and prospective amateurs from the mid-west attended. The feature of the evening was the drawing for an RME-45 receiver. Frank J. Snyder W8BXR, the lucky ticket holder, active on 10 and 160 for many years, was just as jubilant as non-winners were disappointed.

The program arranged by Earl S. Nelson, W8DS, CRA President and his committee, was MC'd by "Doc" Howe (W8EBJ), club Treasurer. After a generous and excellent meal the festivities got under way with an outline by Central Division Director John Kiener, W8AVH, on the frequency situation and the possibilities of opening the bands. Morrie Pierce of WGAR, recently returned from service with OWI, gave an outline of his work during the war with propaganda broadcasting and the part he played in the surrender of the Italian Fleet. The drawing for the RME and much other useful gear then took place, with tubes, meters, volt-ohm-

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What is your occupation or profession.....

milliammeters, parts etc., going as door prizes.

Cuyahoga Radio Association, one of the few amateur organization fully active during the war, sponsored the event to finance the purchase of a receiver and other operating equipment for the Club station located in one of Cleveland's Red Cross building. Members furnish emergency communication for the Red Cross on all bands. The officers are Earl S. Nelson, W8DS, President, Wm. B. Davis, W8JNF, Vice President, Mildred Wildman, W8PZA, Secretary and D. L. "Doc" Howe W8EBJ, Treasurer.

Canada is following the FCC plan of shifting call areas to equalize distribution and to provide additional room. Effective April 1st, the set up north of the border will be as follows: VE1, Maritime Provences; VE2, Province of Quebec; VE3, Ontario; VE4, Manitoba; VE5, Saskatchewan; VE6, Alberta; VE7, British Columbia; VE8A through VE8L, Yokun Territories, and VE8M through VE8Z, Northwest Territories.

— · · · — · —

New calls issued for Colorado, Nebraska, North and South Dakota, Kansas, Minnesota, Iowa and Missouri will carry the *W-zero* prefix. However, the FCC has, for the time being, decided to leave *W9* prefixes in these states.

CALLS HEARD

[*from page 42*]

28 megacycles 12-31-45

W1NBM, W2CTL, W2IJG, W2JXH, W2-OMN, W3BES(CW), W3HQJ, W3GME/4(CW) W4AIS, W8BDT, W8EUQ, W8LMW, W9BAF, W9EOY, W9KKR, W9QVM/9(CW).

14 megacycles

PY2HT, PY4EJ(A3), PY2NX, PY2KT, LU-8DR, LU5DA, TI2OR(A3), EL4S, (Also heard were seven W's calling or working 28 mc, but radiating on 14 mc.)

14 megacycles, 1-2-46

I1USA (A3), I1ZZ, I1UK, I1MZ, I1DA, I1CA(A3), I1GB(A3), PA*0*MP, PA*0*UF, SU1-USA(3), EP5SO, EI8H, LU6DJK, LU8EN, OY3C, PR1AA, B1G, F8QIQ, LS3JU, LZ1XX, D4ANC, G3AX(A3), W9BND/ETO, NX1AA, HB9J, HB9AW, HB9S, HB9CE, HB9AB, ZP6AB, SU1USA.

14 megacycles, 1-5-46

SU1USA, ON4GBB, VS1FB, W4HDE/ETO.

Full details may be obtained by dropping a card to Calls Heard Department, CQ, 342 Madison Avenue, New York 17, N. Y.

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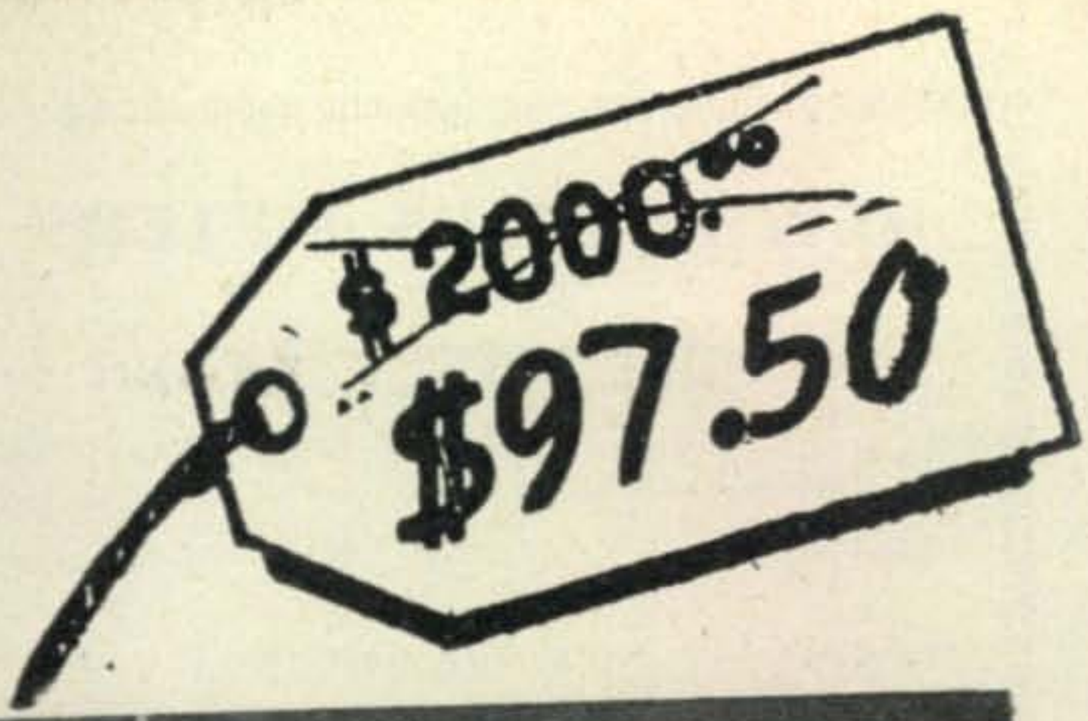

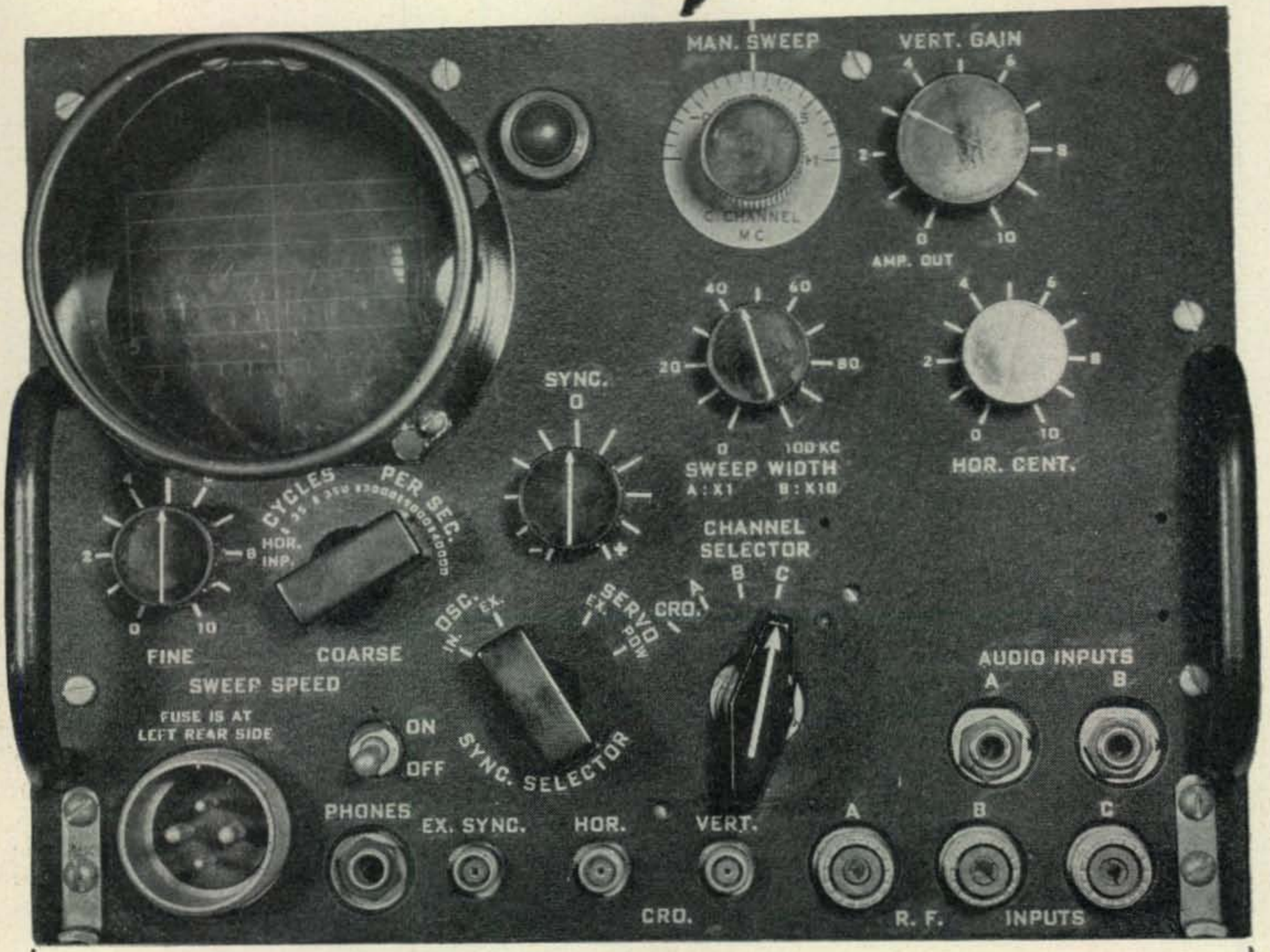

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PARTS AND PRODUCTS

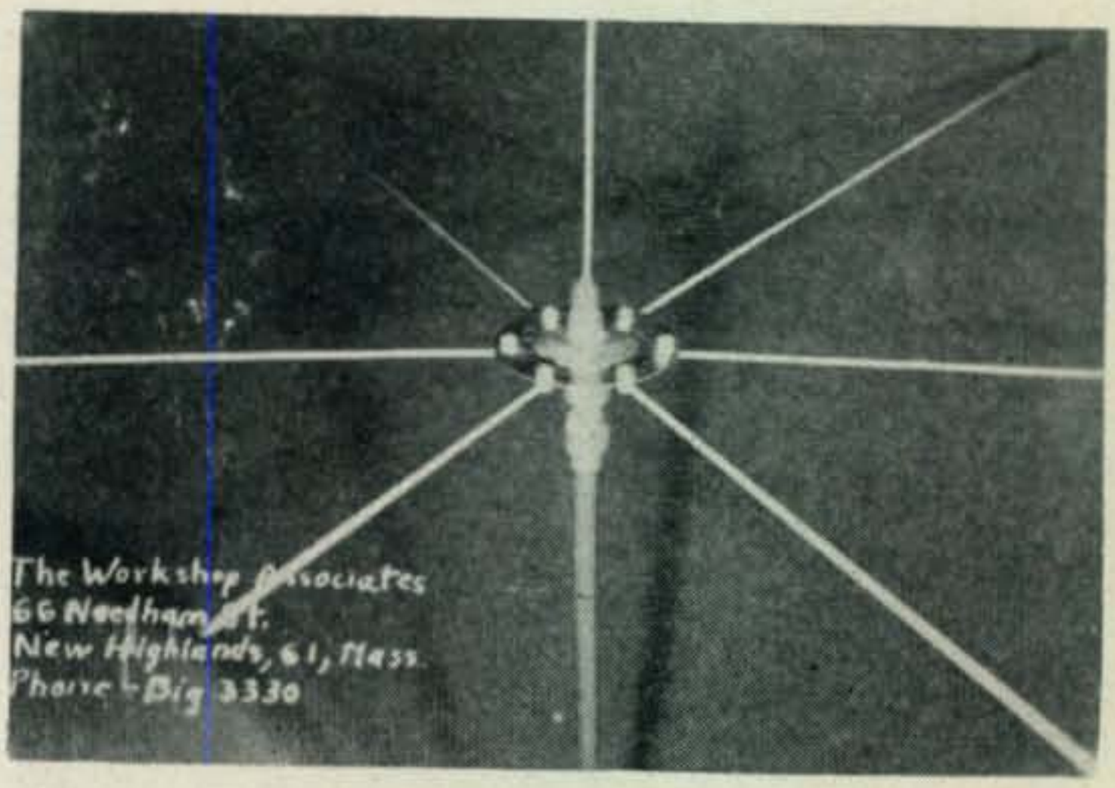
[*from page 48*]

modulated with a maximum modulation factor of 1.0: d-c plate volts—1000; d-c grid No. 1 volts—200; d-c grid No. 2 volts—300; d-c plate current—85 ma; d-c grid current—10 Ma; Peak RF Grid input voltage—250; Driving power—2 watts; Plate power output—60 watts.

AMATEUR GROUND PLANE ANTENNA

A ground plane antenna for amateur use on 144-148 mc and 220-225 mc has just been announced by The Workshop Associates, Newton Highlands, Mass..

Originally designed and manufactured for the air corps to operate at much higher frequencies,



the new antenna offers all the advantages of this widely used design in kit form. The radiating dipole and the six radials are made in two pieces. By screwing on the seven additional pieces, the antenna is converted from the 200 mc band to the 144 mc band—no further adjustments are necessary.

Extremely low loss is encountered by using standard 72 ohm co-axial cable, such as RG-11/u, and show an even better performance using 50 ohm co-ax such as RG-8/u, RG-9/u, or RG-10/u. This compact ground plane antenna gives a uniform coverage in all directions. It comes supplied with a type "N" UG-21/u silver plated weatherproof connector that can be used with any of the above mentioned cables.

POCKET MULTITESTER

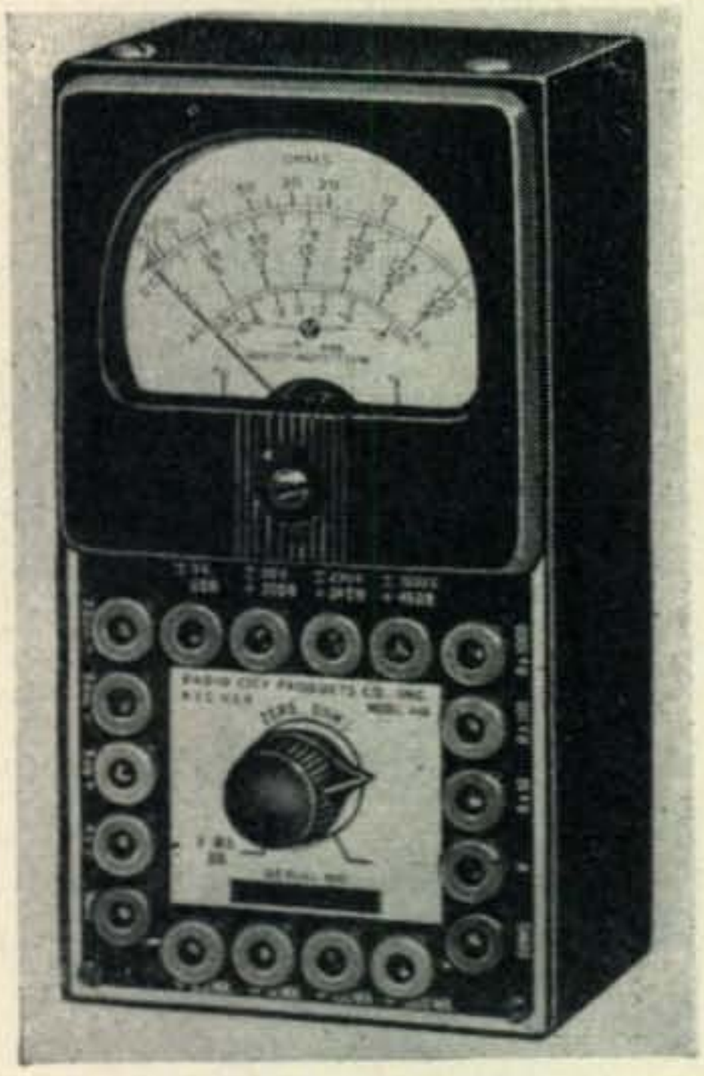
The new Model 448 Pocket Multitester offered by Radio City Products Co., New York, features six testing instruments of high accuracy in one compact metal case. For easy reading, a 3" square meter is used, with a movement of 200 microamperes and a sensitivity of 5000 ohms per volt. Ranges of Multitester are:

DC Voltmeter 0-5-50-250-1000 volts — First scale division—0.1 volt;
AC Voltmeter 0-5-50-250-1000 volts — First scale division—.1 volt;
Output voltmeter 0-5-50-250-1000 volts—First scale division—0.1 volt;
DC milliammeter .5-10-100-1000 ma — First scale division—.01 ma;
Ohmmeter 0/1000 0/10,000 0/.1 meg 0/1 meg;
Decibel meter −6 to +10 −14 to +26 −28 to +40 −40 to +52 db

Db range is calibrated for a line of 500 ohm impedance. For lines of other impedance, correction charts are supplied. The Model 448 Pocket Multitester is 5⅞" x 3⅛" x 2⅛". It weighs only 1¾ lbs., complete with self-contained batteries, ready to operate in snap spring contact holders.

VOLT-OHM-MILLIAMMETER

A new Volt-Ohm-Milliammeter, Model 424, is announced by Radio City Products Co., New York. This instrument uses a three inch meter with a sensitivity of 2500 ohms per volt and a movement of 400 microamperes. High milliammeter range is ten megohms with a center to full scale ratio of 125. The low ohm scale reads 5 ohms at center and 0.1 ohm at each of the first ten divisions. Each shunt and multiplier is individually calibrated, tolerance 1%. Uniform AC-DC voltmeter sensitivity of a thousand ohms per volt. A suppressor-type



Radio City Products Volt-Ohm-Milliammeter Model 424

copper oxide rectifier is used for AC measurements. Ranges of the Volt-Ohm-Milliammeter are: DC Voltmeter 0-2.5-10-50-250-1000 volts; AC Voltmeter 0-10-50-250-1000 volts; DC Milliammeter 0-10-50-250-1000 ma; Ohmmeter 0-500-100,000 ohms; 1-10 megohms; Decibel meter −10 to +29, −18 to +43, −30 to +55 db. Db range is calibrated for a line of 500 ohm impedance.

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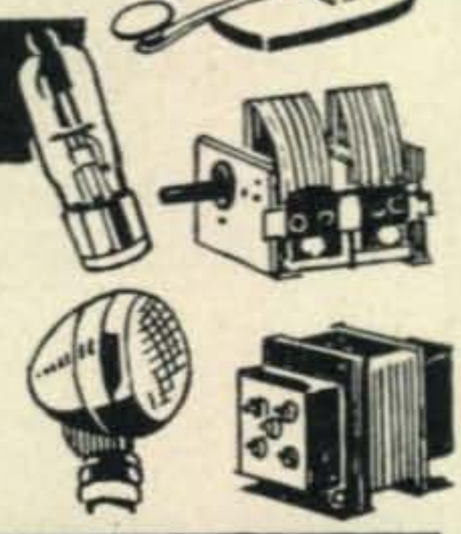

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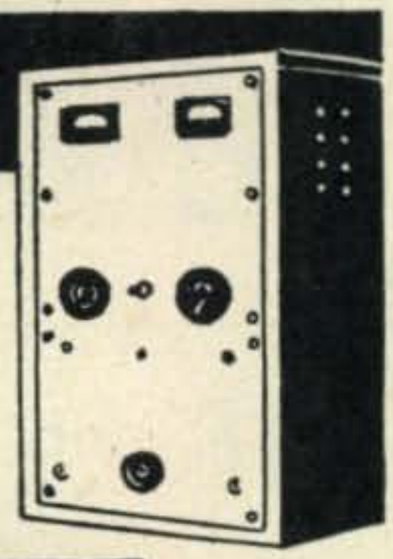

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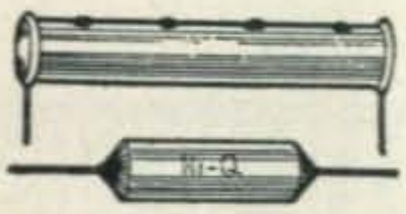

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. . . while our emphasis is on fundamentals, antenna, and all kinds of ham gear, short stories, human interest articles, and your own new ideas are welcome . . .

— . . . —

. . . and *CQ* reserves space for photos of rigs, DX, dope on clubs and hamfests, amateur personalities—and calls logged as we begin to get back to the swing of things . . .

— . . . —

Proof of citizenship is no longer generally required in applications for operating licenses. However, fingerprints must still accompany form 735A unless already on file with the FCC.

CQ DX

[*from page 44*]

CQ is reserving plenty of space for DX. In all of ham radio there is nothing quite as interesting as DX (to a DX man). Information should be as complete and include frequency wherever possible. QSL address, time of QSO, equipment used to make the contact . . . or to hear the DX station, are the kind of thing desired. Photographs of DX stations, both USA and foreign are welcome. DX is a reader's column. If enough good stuff comes in, W6QD might even stop working W9's to take a crack at it. (LK)

ZERO BIAS

[*from page 5*]

of marked-down war surplus equipment would be of considerable benefit to veterans and others who have not reaped financial gains during the period of conflict. And, by making this material available *at once*, the competition with private industry can be largely avoided. (While you can place your order now, much standard and advertised equipment is promised only for future delivery.) However, when reconversion is completed and amateur parts are again on the production line, the eventual release of war surpluses might conceivably cut inroads into radio manufacturing then current.

In the meantime, we suggest that you buy

what you want and require, when and where you can get it. Don't wait too long or too expectantly for war surplus bargains. While a pair of heavy-duty cutters, well greased with vaseline, will survive twenty-eight years of storage, a radio, *circa* World War II, won't be much of a bargain in 1974.

SHOE BOX

[*from page 39*]

The oscillator is then tuned for smallest shadow. With the indicator grid lead in the FINAL GRID jack, the doubler is similarly tuned for smallest shadow, and the crystal tuning touched up. With the B+ plug, (P_1,) of the final amplifier removed from jack (J_6) to eliminate plate voltage, the final amplifier capacitor is tuned back and forth through resonance. At the same time the neutralizing capacitor is adjusted to the point where the indicator shadow does not flicker. The B+ plug is again inserted in its jack. Next, the indicator grid lead is plugged in the GROUND jack and its cathode lead in the FINAL CATHODE jack. The rig is then tuned for greatest output as judged by a flashlight bulb connected in place of an antenna, and the manner in which the shadow reacts is noted. Thereafter it is possible to retune the final stage and set the antenna coupling by means of the eye alone. With the final tank in resonance the shadow widens, but increasing the antenna coupling closes it again. The rig consumes a total of just under 70 watts. Input to the final plate is 310 volts at 20 to 25 ma, the current varying with the load.

On the Air

A check of the log after only a couple of hours on the air at W2JCR (a mediocre location), shows stations from 6 to 20 miles distant worked with S8 plus to S6 signals, and all reporting excellent stability and speech quality. In addition there are two reports from stations between 40 and 50 miles away which were able to hear the carrier but, because of local noise, could not follow the speech. With about 7 watts input this is no mean showing, especially as conditions on the 5-meter band were only normal at the time.

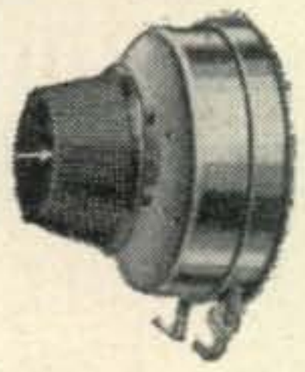
It is planned to change the rig to 6 meters when the shift from 5 meters is authorized. A new crystal, and squeezing the turns of the final a bit, are the only changes expected to be necessary, as the oscillator and doubler will tune to the new band without trouble. The rig will also be used portable-mobile during

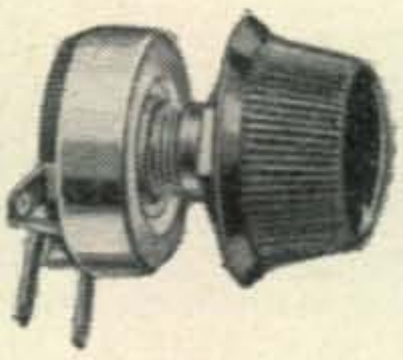
two BIG favorites

MALLORY DRY ELECTROLYTIC CAPACITORS

First manufacturer of commercial high voltage dry electrolytic capacitors, Mallory has applied its skill to the continued perfection of this product. Mallory developments have culminated in the now-universally adopted—and copied—FP and WP capacitors. Use them both for replacement and for the construction of new apparatus—no other capacitors can compare with them.

MALLORY CONTROLS





Mallory pioneered and still leads the field in wire-wound controls including rheostats, potentiometers and pads. For low resistance circuits, or where a higher wattage rating control is required, choose a Mallory wire-wound control. It will pay you every time!

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20 mfd. 150 W.V.	.32
20-20 mfd. 150 W.V.	.55
50-30 mfd. 450 W.V.	.73
Tubular bypass condensers 600 W.V.	
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the summer months with a 75-watt converter on hand from a pre-war stock of accessories. This is a commercial vibrator unit designed to provide 115 volts a-c from the car's battery. The total drain of the rig is well within the limits of this unit.

CONVERTER

[from page 17]

The output transformer occupies a corner of the r-f plate compartment, and the shield between this compartment and the mixer had to be cut off to clear the shield can.

The plate coil is wound on a piece of ¾" polystyrene rod, mounted in the shield can by means of a small aluminum bracket. Coil and link are wound and the entire assembly brushed with polystyrene coil dope. Tuning is by means of a 35 $\mu\mu$f miniature variable capacitor shunted by a 50 $\mu\mu$f zero temperature coefficient capacitor. The lead to the 1852 plate is brought out through a grommeted hole in the side of the shield can nearest the 1852. Other leads pass through grommeted holes in the chassis. The shield can was originally on an i-f transformer. Some experiment with the number of turns on the secondary may lead to a better match with the receiver input.

The ceramic switch for antenna switching is mounted below chassis on a metal bracket. It is well to the rear of the chassis so that leads are short. Control is by means of a piece of ¼" iron shaft passing through a panel bushing. The two switches are a-c on-off and send-receive. The send-receive switch is paralleled with a Jones connector on the back drop of the chassis so that both receiver and converter may be turned off simultaneously, or may be controlled by external swtiches or relays.

Antenna feed is by means of a National FWG assembly, mounted on polystyrene, while output to the receiver is taken from a pair of screw-type terminals on a bakelite strip. Both of these are on the back drop of the chassis.

Operation

Our intention is to employ this converter ahead of the station receiver on the 50, 28, 21, and 14 mc bands. Coils were calculated by means of the ARRL Lightning Calculator, but are subject to minor adjustment for bandspread and tracking.

By leaving off the r-f stage at first and getting the oscillator and mixer operating properly, the remainder of the job becomes a purely mechnaical one. For this reason, we suggest that anyone duplicating the job do so in the same manner.

With everything in the oscillator and mixer

sections wired, the tubes and coils are inserted, and the antenna connected to the link winding on the 1852 grid coil. The power is turned on and the oscillator frequency checked on the station receiver. We looked for the oscillator signal at about 33 mc with the oscillator tuning capacitor at full capacity. Bandspread checked too great. The tuning capacitor connected to the grid end of the coil was moved down a turn. It was now more nearly correct, and a couple of additional minor adjustments set it correctly.

Next set the station receiver at about 4.3 mc and couple in the converter. The converter output coil is peaked for maximum noise in the receiver. The Meissner Signal Shifter on the operating desk was turned on, supplying us with a calibrated source of r.f. throughout the 28 mc band. The mixer trimmer was adjusted for maximum deflection on the receiver R meter (the 0-1 ma meter previously mentioned).

Tuning across the band we found more bandspread than wanted, so another adjustment was made of the oscillator coil bandspread tap, and the converter tuned from 27.9 to 28.8 mc, covering the band nicely and affording a chance to check out-of-band signals.

The mixer coil was then pruned so that the tuning capacitor tracked across the band. This was done by first peaking the mixer at the low end of the band, using the signal from the Signal Shifter, and the meter as an indicator. The Converter and Shifter were then tuned to the high end of the band and the mixer trimmer realigned for maximum meter deflection. If more capacity is needed to realign the mixer, the coil has too many turns, and vice-versa. Fine adjustments may be made by spreading or compressing coil turns to alter the inductance slightly.

During the course of these adjustments, some interesting observations were made. With the receiver alone operating (converter disconnected) the Signal Shifter deflected the meter needle to approximately two-thirds scale. With the converter feeding the receiver, the reading went entirely off the meter scale, the needle stopping when it reached the pin. We don't know how many db difference this represents, but the variation is considerable.

Before the r-f stage was added, the converter was placed in operation as described above. Signals immediately took a great jump in strength, as did the noise level. The signal level increase was, however, relatively much greater than the noise level increase. It was now possible to turn down the receiver a-f gain control to approximately ¼ open, to achieve comfortable room volume as compared with full audio gain without the converter. These tests were all made with a simple dipole antenna.

The r-f stage was then added, the coils being

HAMFESTERS RADIO CLUB

Cyrus T. Read, veteran Chicago radio amateur, was elected president of the Hamfesters Radio Club, Inc., local affiliate (Chicago, Ill.) of the American Radio Relay League.

Other officers elected include: Howard Hinman, vice-president; Clarence Zornes, recording secretary; Harry Gartzman, financial secretary; Lawrence Gross, treasurer; and Edward Costello, sergeant-at-arms. Retiring president, William S. Soich, automatically moves to the position of chairman of the Executive Committee.

The organization is one of the largest of its kind in the country, with a pre-war membership approaching 500. The return from service of former members, many of whom held important positions in the field of electronics during the war, is rapidly swelling the club's roster to nearly its pre-war peak.

The club was one of the few organizations of its kind to hold regular meetings throughout the war.

TAB

SPECIAL BUY

(Limited Quantity)

ELECTRONIC VOLT-OHMETER BRAND NEW U. S. ARMY TYPE 1-107-F PRECISION UNIT

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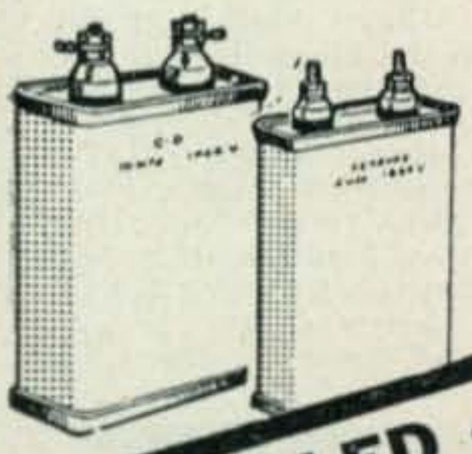

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made identical with the mixer grid coil, with the exceptions as noted earlier. Both these tracked very accurately, indicating that the experimenting with the mixer coil had paid dividends. In order to measure further signal strength gains, it was necessary to readjust the R meter, making any comparison with the receiver alone invalid. However, it was at once apparent that a further increase of approximately two R's had been achieved. The converter has been in daily use and we've heard plenty of signals not even readable on the receiver alone.

450 WATT CW RIG

[*from page 33*]

bias voltage without affecting the 807 bias. The miscellaneous circuit capacities and high values of resistors in this keying circuit give enough delay characteristic to eliminate nearly all of the key clicks. A word of caution, any cw transmitter may radiate bad key clicks if one of the r-f stages has a tendency toward either high or low frequency parasitic oscillation. Contrary to popular belief, even doubler or tripler stages are not free from possible parasitic trouble.

The r-f amplifier is easily tuned for operation by neutralizing and adjusting the final grid current to at least 50 ma. An ordinary 600 watt electric heater replacement element makes a convenient high and low power control for final amplifier supply if no taps are available on the transformer primary. The voltage regulation with the resistor in the primary is poor and an auto-transformer or primary taps are more desirable in cw service for reducing power input to the final amplifier stage.

(Editors Note: After using this transmitter for some time trouble was encountered with 811 tube failures. The cure was simple. A small cathode resistor, either 100 ohms 50 watt, or a 100 watt mazda lamp in the C.T. lead to the ground in the 811 r-f amplifier.)

MORE ON SURPLUS

[*from page 29*]

considerable number of SCR 211 Army Signal Corps type frequency meters available, which may be modified to ECO use. Most dealers anticipate a fairly plentiful supply of this item, which is an excellent piece of all-around ham equipment. As a frequency meter it is invaluable—doubling as an ECO it provides precise frequency control.

Receivers and Test Equipment

Receivers have been scarce, although indications are that some are beginning to appear on the surplus market. A recent example is where a quantity of the most expensive stock communications receivers available before the war were released for under one hundred dollars. They were a wonderful investment and sold rapidly. The surplus models do not include either the ten meter amateur band, the broadcast band, or the generous bandspread available on the commercial models.

Test equipment has also appeared in limited quantities, but so far has not been generally available. Further reports will appear in *CQ* as information becomes available. Remember the important rules and you can't go wrong on surplus. Don't buy just because prices are low! Much of the material is obsolete; in certain lines new and better things are coming out every day, and no surplus carries a guarantee.

RECEIVER SELECTIVITY

[*from page 21*]

is down 6 db at 100 cycles on either side of the center frequency, and more than 40 db at 225 cycles on either side. Type 53091 is the same except that the 6 db points are 150 cycles on either side of 1000 cycles.

It is suggested that the users of commercial receivers for c.w. reception indicate an interest in this combination to encourage the manufacturers to incorporate the audio filter in their new models, even at an additional cost of several dollars. Those who already have a receiver and desire to improve it, can construct or procure a filter and insert it in the phone lead or in the audio system of the receiver.

NARROW BAND FM

[*from page 8*]

was to be reversed and the A.M. station was R-3 and the QRM was of equal intensity, it is impossible to copy the signal. A higher signal-to-noise ratio will *always* be obtained when using narrow band F.M.

Design Considerations

The practical side of the subject is the primary consideration in this introductory article. As shown in *Fig. 1*, the reactance tube modulator is the most practical from the standpoint of cost, flexibility, high quality and low distortion, all features of narrow band F.M. Previously, the

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reactance tube modulator was looked upon to be a device for supplying large amounts of deviation. However, with narrow band F.M. we can make better use of the reactance modulator by substituting a large swing for a narrow swing and using what is left over for sensitivity in regard to audio gain. By having one stage of audio, resistance coupled to the reactance modulator, more adequate gain for a crystal mike or any other high impedance quality microphone having an output of from −70 db to −52 db will be available.

Where frequency stability is of the utmost importance, the circuit shown in *Fig. 2* is used. The reactance modulator is very sensitive to voltage variations and temperature changes, therefore the stability of the oscillator would be poor. By the use of an automatic frequency control system, it is possible to obtain crystal control effect. For maximum stability, the discriminator transformer should have a low frequency of 270 kc. The bandwidth of the discriminator is 4 kc. By tapping off a small voltage from the oscillator circuit and feeding it into the mixer tube, a beat frequency, similar to a mixer in a conventional superheterodyne receiver is produced. When the electron-coupled oscillator is set for the difference of the crystal oscillator frequency and the discriminator frequency, the d-c output voltage of the discriminator is zero. If the E.C.O. should change frequency due to voltage fluctuations or temperature changes, the A.F.C. would produce an output voltage in the opposite direction to the reactance tube, changing the grid bias and restoring the oscillator back to its frequency. This method of crystal control is quite popular among the commercial F.M. transmitters now in use.

In *Fig. 2*, it will be observed that the audio component is resistance coupled to a triode which feeds a rectifier type voltmeter. This is very helpful as the actual amount of deviation can be calibrated and used to check the transmitter for so-called 100% modulation. Actually, the per cent of modulation in an F.M. transmitter is meaningless, but since we have set a standard for a 6 kc swing, that swing may be called 100% modulation.

The r-f line up for a narrow band F.M. transmitter is identical to an A.M. transmitter. In reality, the amount of r-f drive to the final stage is far less—equivalent to the operating conditions of a c.w. transmitter. In designing a transmitter of this type, it will be found that the small receiving beam tubes such as the 6V6 or 7C5 are ideally suited as they are extremely easy to drive and lend themselves very nicely to frequency multipliers. Of course, conventional combinations of tubes may be used.

Let us look at the power supply for a moment

and see what is required for the final amplifier. As the most expensive item of the rig this is of particular interest. The final amplifier is operating under Class C telegraphy conditions and the plate current is always constant, so a conventional type of condenser input power supply could be used to F.M. modulate. If we were to plate modulate the final amplifier a power supply of excellent voltage regulation with additional components would be required.

The obvious saving in modulation equipment, coupled with the high efficiency of frequency modulation makes it a natural for ham use. Rather than cover the subject in its entirety at one time, this article has attempted to point out certain basic facts and advantages. March *CQ* will describe a complete 360 watt narrow band F.M. transmitter for ten meter operation employing all the features emphasized this month. An analysis of individual circuits will make it possible to try F.M. for yourself. Following this transmitter, several modulators will be thoroughly described, the series extending to cover elementary and advanced theory through construction of F.M. equipment.

8JK BEAM

[*from page 11*]

the spreader and center insulator with #14 soft copper wire. The only remaining operation is to attach the two 4″-feeder suspension insulators to the eye hooks mounted on the center oak spreader. A jumper consisting of #12 soft drawn-copper wire is connected from the feeders to each side of the center insulator, wrapped around three times, and soldered.

In order to suspend the array, 3/8″ manilla hemp rope should be used to provide strength. Two 14′ pieces are cut and each end tied to the staple plates located on the back of the two oak end spreaders. The main tie ropes can now be tied to the exact center of the two 14′ lengths and the entire array hoisted into the air. It is desirable that the antenna be raised at least ½ wave or 33′ above ground, and in the clear, in order that the radiation pattern will not be distorted.

Guys should be used when necessary. Further constructional details are shown in *Fig. 4* and the photographs.

The author, using a duplicate of the antenna system described here, was rewarded with three-hundred Asiatic contacts during the first year of operation from a Long Island location which is notoriously poor for the reception from that part of the world. The effort and time consumed in its construction will be compensated by an array which is highly efficient and mechanically rugged.

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